3-18-2009

Idaho Dairymen's Ass'n v. Gooding County Clerk's Record v. 3 Dckt. 35980

Vol 3 of

#35980-2008 Vol #3

LAW CLERK

IN THE

SUPREME COURT

OF THE

STATE OF IDAHO

Idaho Dairymens Assn

Plaintiff and

Appellant

VS.

Gooding County

COPY

Defendant and

Respondent

Appealed from the District Court of the 5th Judicial District for the State of Idaho, in and for Gooding County

Hon. Barry Wood District Judge

Kenneth McClure

Givens Pursley

Attorney for Appellant

Calvin Campbell / Lurene Shaw

Gooding County

Attorney for Respondent

FILED - COPY

Filed this ____ day of ____, 19__

MAR 18 2009

Clerk

Supreme Court Court of Appeals

Entered on ATS

By ____ Deputy

35980

IN THE SUPREME COURT OF THE STATE OF IDAHO

IDAHO DAIRYMEN'S ASSOCIATION,
And IDAHO CATTLE ASSOCIATION,
Plaintiff/Appellants,

Vs.

GOODING COUNTY,
Defendant/Respondent.

COPY

Supreme Court No. 35980-2008
CLERK'S RECORD ON APPEAL

Appeal from the District Court of the 5th Judicial District of the State of Idaho, in and for the County of Gooding

****

HONORABLE BARRY WOOD, DISTRICT JUDGE

****

Kenneth McClure
GIVENS PURSLEY, LLP
P.O. Box 2720
Boise, ID 83701-2720

Calvin Campbell
GOODING COUNTY PROSECUTOR
P.O. Box 86
Gooding, ID 83330

VOL 3

CHRONOLOGICAL INDEX

ALPHABETICAL INDEX

Idaho Dairy Association, Inc., Idaho Cattle Association vs. Gooding County Board Of Commissioners

Date	Code	User		Judge
1/9/2007	NCOC	CYNTHIA	New Case Filed - Other Claims	Barry Wood
10/9/2007	APER	CYNTHIA	Plaintiff: Idaho Dairy Association, Inc., and Idaho Cattle Association Appearance Kenneth McClure	Barry Wood
	APER	CYNTHIA	Defendant: Gooding County Board Of Commissioners Appearance Calvin H. Campbell	Barry Wood
		CYNTHIA	Filing: G3 - All Other Actions Or Petitions, Not Demanding $ Amounts Paid by: Idaho Dairy Association, Inc., (plaintiff) Receipt number: 0004379 Dated: 10/9/2007 Amount: $88.00 (Check) For: Idaho Cattle Association, (plaintiff)	Barry Wood
	SMIS	CYNTHIA	Summons Issued	Barry Wood
11/5/2007	AFFD	CYNTHIA	Affidavit of Service/Summons Returned	Barry Wood
	NOAP	CYNTHIA	Special Appearance (I.R.C.P. 4(i)(2)	Barry Wood
11/16/2007	MOTN	CYNTHIA	Motion IRCP 12(b)(2); 12(b)(4); 4(i)(2)	Barry Wood
	HRSC	CYNTHIA	Hearing Scheduled (Motion to Dismiss 01/08/2008 11:00 AM)	Barry Wood
	NTHR	CYNTHIA	Notice Of Hearing By Parties	Barry Wood
11/30/2007	MISC	CYNTHIA	Written Consent to file Amended Complaint	Barry Wood
	AMCO	CYNTHIA	Amended Complaint Fof Declaratory and Injunctive Relief	Barry Wood
2/6/2007	NOAP	CYNTHIA	Notice Of Appearance by Calvin Campbell on behalf of the County	Barry Wood
2/10/2007	ACSV	CYNTHIA	Acceptance Of Service	Barry Wood
	AFSV	CYNTHIA	Affidavit Of Service	Barry Wood
/17/2007	ANSW	CYNTHIA	Answer and Statement of Affirmative Defenses	Barry Wood
	MOTN	CYNTHIA	Motion to Dismiss	Barry Wood
/2008	HRVC	CYNTHIA	Hearing result for Motion to Dismiss held on 01/08/2008 11:00 AM: Hearing Vacated	Barry Wood
4/2008	REQD	CYNTHIA	Request For Discovery	Barry Wood
)/2008		CYNTHIA	Miscellaneous Payment: For Making Copy Of Any File Or Record By The Clerk, Per Page Paid by: Richard Carlson Receipt number: 0000411 Dated: 1/29/2008 Amount: $16.00 (Check)	Barry Wood
/2008	NTSV	CYNTHIA	Notice Of Service	Barry Wood
2008	MISC	CYNTHIA	Set Trial letter to counsel	Barry Wood
)08	NORT	CYNTHIA	Note Of Issue/request For Trial (by Plaintiff)	Barry Wood
2008	HRSC	CYNTHIA	Hearing Scheduled (Court Trial 11/18/2008 09:00 AM)	Barry Wood
	HRSC	CYNTHIA	Hearing Scheduled (Pretrial Conference 10/28/2008 10:30 AM)	Barry Wood
	PTSO	CYNTHIA	Pre Trial Scheduling Order Issued	Barry Wood
)08	NORT	CYNTHIA	Note Of Issue/request For Trial (by Defendant)	Barry Wood

Idaho Dairy Association, Inc., Idaho Cattle Association vs. Gooding County Board Of Commissioners

Date	Code	User		Judge
4/23/2008	MOTN	CYNTHIA	Motion for Disqualification of Alternate Panel Judge (Butler)	Barry Wood
4/29/2008	ORDR	CYNTHIA	Order for Disqualification of Alternate Panel Judge (Butler)	Barry Wood
7/18/2008	DISC	CYNTHIA	Disclosure Of Witnesses Lay Or Expert	Barry Wood
	MOTN	CYNTHIA	Motion for Summary Judgment	Barry Wood
	MEMO	CYNTHIA	Memorandum of Law in Support of Motion	Barry Wood
	MISC	CYNTHIA	Idaho Dairymen's Element Sheet in Support	Barry Wood
	AFFD	CYNTHIA	Affidavit of Anthony Brand in Support	Barry Wood
	AFFD	CYNTHIA	Affidavit of Mathhew Thompson in Support	Barry Wood
	AFFD	CYNTHIA	Affidavit of Gregory Ledbetter DVM in Support	Barry Wood
	AFFD	CYNTHIA	Affidavit of Marv Patten in Support	Barry Wood
	AFFD	CYNTHIA	Affidavit of Debora Kristensen in Support	Barry Wood
	MISC	CYNTHIA	Defendant's ADR Statement	Barry Wood
7/21/2008	DISC	CYNTHIA	Disclosure Of Witnesses Lay Or Expert	Barry Wood
	NTHR	CYNTHIA	Notice Of Hearing By Parties	Barry Wood
7/22/2008	HRSC	CYNTHIA	Hearing Scheduled (Motion for Summary Judgment 08/26/2008 01:30 PM)	Barry Wood
7/28/2008	MOTN	CYNTHIA	Motion to Continue	Barry Wood
	STIP	CYNTHIA	Stipulation to Continue	Barry Wood
	CONT	CYNTHIA	Continued (Motion for Summary Judgment 09/02/2008 01:30 PM)	Barry Wood
/30/2008	ORDR	CYNTHIA	Order to Continue Hearing	Barry Wood
'5/2008	DISC	CYNTHIA	Disclosure Of Witnesses Lay Or Expert	Barry Wood
14/2008	MISC	CYNTHIA	Volume 2 begins	Barry Wood
15/2008	AFFD	CYNTHIA	Affidavit of John Horgan in Opposition to Plfs Motion for Summary Judgment	Barry Wood
	MOTN	CYNTHIA	Motion to Strike Affidavits	Barry Wood
	NTHR	CYNTHIA	Notice Of Hearing By Parties	Barry Wood
	AFFD	CYNTHIA	Affidavit of Paul Kroeger in Opposition	Barry Wood
	MISC	CYNTHIA	Defendant's Responsive Element Sheet	Barry Wood
	MISC	CYNTHIA	Brief in Opposition	Barry Wood
3/2008	AFFD	CYNTHIA	Affidavit of Tom Faulkner in Opposition	Barry Wood
3/2008	AFFD	CYNTHIA	Second Affidavit of D Kristensen in Support	Barry Wood
	MOTN	CYNTHIA	Idaho Dairymens Response to Motion to Strike Affidavits	Barry Wood
/2008	MISC	CYNTHIA	Plfs Reply to Defendant's Opposition....	Barry Wood
008	CMIN	CYNTHIA	Court Minutes Hearing type: Motion for Summary Judgment Hearing date: 9/2/2008 Time: 1:30 pm Court reporter: Linda Ledbetter Audio tape number: Dc 08-10	Barry Wood

Idaho Dairy Association, Inc., Idaho Cattle Association vs. Gooding County Board Of Commissioners

Date	Code	User		Judge
9/2/2008	HRHD	CYNTHIA	Hearing result for Motion for Summary Judgment held on 09/02/2008 01:30 PM: Hearing Held and Motion to Strike Affidavits	Barry Wood
9/3/2008	DISC	CYNTHIA	Disclosure Of Witnesses Lay Or Expert	Barry Wood
	ADVS	CYNTHIA	Case Taken Under Advisement	Barry Wood
9/17/2008	NTSV	CYNTHIA	Notice Of Service	Barry Wood
9/18/2008	MISC	CYNTHIA	Defendants Disclosure of Unavailable dates for Trial	Barry Wood
10/1/2008	MISC	CYNTHIA	Plaintiffs Unavailable Dates	Barry Wood
10/16/2008	NTSV	CYNTHIA	Notice Of Service	Barry Wood
	MISC	CYNTHIA	Answers to Plaintiffs First Set of Interrogatories....	Barry Wood
10/22/2008	HRVC	CYNTHIA	Hearing result for Pretrial Conference held on 10/28/2008 10:30 AM: Hearing Vacated	Barry Wood
	CONT	CYNTHIA	Continued (Court Trial 04/21/2009 09:00 AM)	Barry Wood
	HRSC	CYNTHIA	Hearing Scheduled (Pretrial Conference 03/31/2009 10:30 AM)	Barry Wood
10/23/2008	MISC	CYNTHIA	Supplemental Answers to Plfs Interrogatories and Request for Production	Barry Wood
10/28/2008	ORDR	CYNTHIA	Order on Plaintiff's Motion for Summary Judgment (Denied) and Defendant's Motion to Strike (Denied); Defendant's Motion for Summary Judgment Granted	Barry Wood
	FJDE	CYNTHIA	Final Judgement, Order Or Decree Entered	Barry Wood
	STAT	CYNTHIA	STATUS CHANGED: Closed	Barry Wood
1/6/2008	JDMT	CYNTHIA	Judgment	Barry Wood
2/10/2008	APSC	CYNTHIA	Appealed To The Supreme Court	Barry Wood
	STAT	CYNTHIA	STATUS CHANGED: Inactive	Barry Wood
	NOTC	CYNTHIA	Notice of Appeal	Barry Wood
		CYNTHIA	Filing: T - Civil Appeals To The Supreme Court ($86.00 for the Supreme Court to be receipted via Misc. Payments. The $15.00 County District Court fee to be inserted here.) Paid by: Idaho Cattle Association, (plaintiff) Receipt number: 0005069 Dated: 12/10/2008 Amount: $15.00 (Check) For: Idaho Cattle Association, (plaintiff)	Barry Wood
	VOID	JULIE	Voided Transaction: Receipt or Disbursement (Receipt# 5069 dated 12/10/2008)	Barry Wood
		CYNTHIA	Filing: T - Civil Appeals To The Supreme Court ($86.00 for the Supreme Court to be receipted via Misc. Payments. The $15.00 County District Court fee to be inserted here.) Paid by: McClure, Kenneth R. (attorney for Idaho Cattle Association,) Receipt number: 0005088 Dated: 12/12/2008 Amount: $15.00 (Check) For: Idaho Cattle Association, (plaintiff)	Barry Wood

(a)

Idaho Dairy Association, Inc., Idaho Cattle Association vs. Gooding County Board Of Commissioners

Date	Code	User		Judge
12/12/2008		CYNTHIA	Miscellaneous Payment: For Making Copies Of Transcripts For Appeal Per Page Paid by: Givens Pursley Receipt number: 0005089 Dated: 12/12/2008 Amount: $335.00 (Check)	Barry Wood

ORIGINAL

KENNETH R. McCLURE (ISB #2616)
DEBORA K. KRISTENSEN (ISB #5337)
J. WILL VARIN (ISB #6981)
GIVENS PURSLEY LLP
601 West Bannock Street
P.O. Box 2720
Boise, Idaho 83701-2720
Telephone: 208-388-1200
Facsimile: 208-388-1300
S:\CLIENTS\7263\S\Patten AFF ISO Plaintiff MSJ.DOC

Attorneys for Plaintiffs

IN THE DISTRICT COURT OF THE FIFTH JUDICIAL DISTRICT OF THE STATE OF IDAHO, IN AND FOR THE COUNTY OF GOODING

IDAHO DAIRYMEN'S ASSOCIATION, INC., an Idaho non-profit corporation; THE IDAHO CATTLE ASSOCIATION, INC., an Idaho non-profit corporation,

Plaintiffs,

vs.

GOODING COUNTY, a body politic and corporate of the State of Idaho,

Defendant.

CASE NO. CV-2007-651

AFFIDAVIT OF MARV PATTEN IN SUPPORT OF PLAINTIFFS' MOTION FOR SUMMARY JUDGMENT

STATE OF IDAHO)
) ss.
County of Ada)

MARV PATTEN, being first duly sworn, deposes and says:

1. I am the CAFO/Dairy Bureau Chief at the Idaho State Department of Agriculture ("ISDA") and make this affidavit based on my personal knowledge as such. As Bureau Chief, I oversee and have many responsibilities at the ISDA, including: (1) sanitation compliance and inspection of all milk and other dairy products produced within the state; (2) enforcement of the milk licensing program; (3) management of the dairy environmental program, which includes

enforcing the rules governing dairy waste management; and (4) enforcement of the Beef Cattle Environmental Control Act. Nutrient management is an important component of enforcing both the dairy and beef cattle environmental programs.

2. In Idaho, all Nutrient Management Plans ("NMP") must be prepared by a Certified Nutrient Management Planner and approved by the ISDA.

3. To become a Certified Nutrient Management Planner, one must complete the Nutrient Management Certification Course taught through the ISDA in conjunction with the Natural Resources Conservation Service and the University of Idaho (the "Nutrient Management Course"). Prerequisites to taking the Nutrient Management Course include: (1) completion of the NRCS course entitled "Introduction to Water Quality," and (2) completion of the nutrient management modules of the NRCS course entitled "Nutrient & Pest Management Considerations in Conservation Planning."

4. The Nutrient Management Course covers nutrient cycling through the environment and cropland, soil survey and soil sampling techniques, irrigation management, manure management, and mortality management. During the course, attendees are instructed on the use of Idaho's OnePlan Software, a planning tool for creating certified nutrient management plans in Idaho, and are taken through an example nutrient management plan. Attached hereto as Exhibit 1 is a copy of some of the training materials used in the Nutrient Management Course.

5. After completion of the certification course, an individual is qualified to begin writing NMPs. In order to receive final certification, however, he or she must then draft two plans that are approved by the ISDA.

6. A Certified Nutrient Management Planner prepares NMPs by working in cooperation with the dairy or beef cattle producer. Information gathered during the interview

and/or onsite facility assessment with the producer will supply the planner with the data to complete an initial evaluation of the facility. The planner will draw a site map and delineate information for the land application site plan. Once the planner calculates the initial data, he or she will discuss with the producer any compliance issues. Finally, a NMP is written.

7. NMPs are written to achieve crop production goals while minimizing the environmental impact of nutrients (nitrogen, phosphorus, and potassium) for a specific site. These plans are not "one size fits all"; indeed, they are highly specific to the operation at issue in that they take into consideration herd size, facility design, number of crop acres, soils, climate, and crop productions to: (1) assure proper containment of animal manure and process waste water; (2) assess resource concerns which exist on the property; (3) budget nutrient sources to optimize crop water and nutrient needs. Nutrient sources include commercial fertilizers, animal manure, mineralization of previous crop residues, and irrigation water; and (4) assess irrigation water management to minimize movement of nutrients beyond the root zone or with runoff.

8. To do so, a NMP is required to include the following components: (1) aerial site photograph or map and a soil map; (2) current and/or planned plant productions sequence or crop rotation; (3) results of soil, plant, water and organic sample analyses; (4) realistic yield goals for the crops in the rotation; (5) quantification of all nutrient sources; (6) recommended nutrient rates, timing and method of application; (7) location of designated sensitive areas or resources and the associated practices or methods planned to protect the area; and (8) complete nutrient budget for nitrogen, phosphorus, and potassium for the rotation or crop sequence.

9. A key concern for waste management systems is the concentration of certain nutrients in the soil due to crop fertilizers and livestock waste. The Nutrient Management Code 590 sets forth the technical standards for preventing nutrient pollution, including setting the

Phosphorus Threshold ("TH") concentrations at 40 ppm for surface water runoff. Idaho has a TH standard that is more stringent than many of our neighboring states.

10. If a producer does not have enough acres to utilize nutrients produced from its dairy or feedlot, the producer must purchase additional crop acreage or export the excess animal waste. If the animal waste is exported, the NMP must document the third party receiver, address, contact phone number, and number of acres available for manure application. To remain in compliance with the NMP, a producer must follow ongoing record keeping requirements to document all applied and exported waste. Overall, the NMP provides a complex scientific and technology based approach to managing livestock waste.

11. Once completed, a NMP is submitted to the ISDA for approval. ISDA has a State Nutrient Management Coordinator review each NMP. During the review process, ISDA will communicate with the producer and the Certified Nutrient Management Planner, consult with ISDA inspection staff concerning the plan's site and will often include a visit to the site. Following the review process, the NMP will either be approved or denied. If the plan is denied, ISDA will provide the certified planner and producer with guidelines for revising the plan.

12. ISDA's regulation of animal waste management systems does not end following its approval of a NMP. ISDA enforces all NMPs plans through unannounced inspections.

13. In 2006 and 2007, the ISDA conducted 1,174 statewide waste inspections of beef cattle facilities, and it conducted 20 inspections on the 29 beef facilities located in Gooding County. In 2006, Idaho had 684 dairy farms, and the ISDA conducted 1,913 dairy farm waste inspections resulting in an average of 2.8 annual inspections per dairy. During the ten-year history of the [Dairy] MOU, 1996 through 2006, ISDA conducted 26,445 dairy farm waste inspections. A total of 3,747 noncompliance violations and 973 discharge violations were

issued. Gooding County has 99 dairy producers, and in 2006 and 2007, the ISDA conducted a total of 703 inspections on those producers. Attached hereto as Exhibit 2 is a true and correct copy of data that I pulled from IDSA's records, detailing historical statistics for statewide and Gooding County dairy producer and beef facility inspections.

14. If a site is not in compliance with its NMP, it can receive substantial fines. In 2006, ISDA cited 7 dairy farms resulting in civil penalties of $69,900 for violation of the Rules Governing Dairy Waste. When assessing a dairy waste penalty, ISDA uses a matrix as a guide in determining the appropriate penalty for the violation. Attached hereto as Exhibit 3 is a true and correct copy of the ISDA's Dairy Waste Permit Suspension Guidelines and Matrix (effective April 2000).

15. When assessing a penalty for beef cattle waste, ISDA also uses a matrix as a guide in determining the appropriate penalty for the violation. Attached hereto as Exhibit 4 is a true and correct copy of the ISDA's Beef Cattle Animal Feeding Operations Enforcement Guidelines and Matrix (effective May 2008).

FURTHER, YOUR AFFIANT SAYETH NAUGHT.

Marv Patten

Marv Patten

SUBSCRIBED AND SWORN before me this 26 day of June 2008.

KAREN M. EWING NOTARY PUBLIC STATE OF IDAHO

Notary Public
Residing at: Boise, ID - Ada County
My Commission Expires: 5-17-2011

CERTIFICATE OF SERVICE

I hereby certify that on the 17th day of June 2008, a true and correct copy of the foregoing was served upon the following individual(s) by the means indicated:

Calvin H. Campbell
John L. Horgan
Gooding County Prosecuting Attorney's Office
624 Main Street
P.O. Box 86
Gooding, ID 83330
Facsimile (208) 934-4494

- ☐ U.S. mail, postage prepaid
- ☒ express mail
- ☐ hand delivery
- ☐ facsimile

Clive Strong
State of Idaho
Office of Attorney General
700 West State Street
P.O. Box 83720
Boise, ID 83720-0010

- ☐ U.S. mail, postage prepaid
- ☐ express mail
- ☒ hand delivery
- ☐ facsimile

Debora K. Kristensen

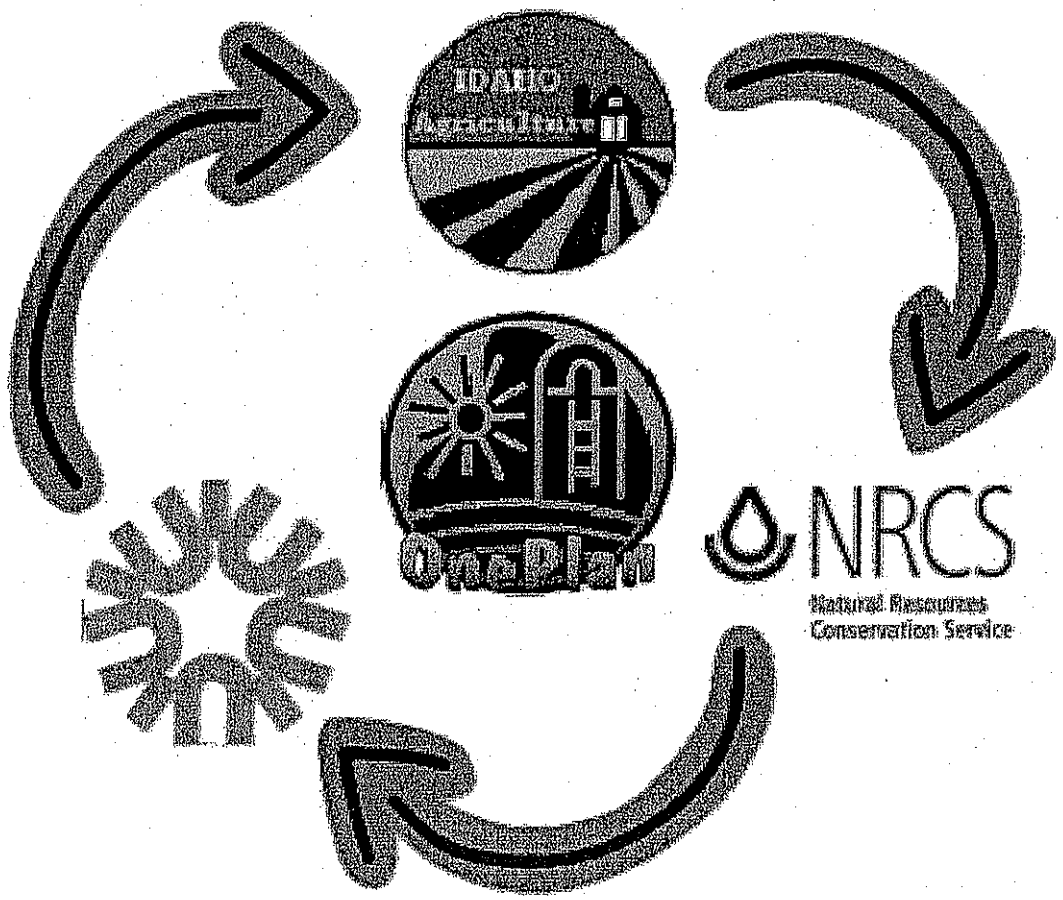
EXHIBIT 1

OnePlan

Comprehensive Nutrient Management Plan

(CNMP)

Certification Training



366

WELCOME

NUTRIENT MANAGEMENT CERTIFICATION COURSE

Basic Certification

OUR GOAL:

- Promote Nutrient Management
- Work with Industry and University to that end.
- Encourage private industry to participate in the nutrient management planning process.

- Get you certified.

Objective for this session:

- Complete the certification process for most of you
- Give you a background / understanding of OnePlan NMP.
- Demonstrate OnePlan (you participate).
- Have you complete at least one exercise.

Basic Certification Requirements

- Complete NEDC course work.
- Write 2 plans reviewed & approved by:
  - NRCS for NRCS. SCC, IASCD staff
  - ISDA for consultants.

Quality Control

- NRCS:
  - Annual status review of all cost share contracts.
  - Field Office reviews.
- ISDA: Ongoing inspection program

OnePlan

Comprehensive Nutrient Management Plan
(CNMP)
Certification Training

AGENDA

September 20-22
CSI – U of I Extension
Twin Falls

Tuesday, Sept 20th

8:00	8:15	Welcome / Overview	Fisher
8:15	9:00	State and Federal Rules and Regulations	McRae
9:00	9:45	NRCS Nutrient Management Standard	Johnson
9:45	10:00	Break	
10:00	11:15	NRCS Risk Assessment (SISL, RUSLE2, P Transport)	Fisher
11:15	12:00	Nutrient Cycle	Ellsworth
12:00	1:00	Lunch	
1:00	1:45	Soil Sampling / U of I Fertilizer Guides	Ellsworth
1:45	2:45	Irrigation Water Management / Systems	Neibling
2:45	3:15	Background of AFO/CAFO Production Livestock	Olsen
3:15	3:30	Break	
3:30	4:00	Sizing of Waste Storage Structures	Beddoes
4:00	4:45	Nutrient Calculations	Olsen
4:45	5:00	Bio-Nutrient Sampling and Analysis	Olsen

Wednesday, September 21st

8:00	8:45	Manure Application	Beddoes
8:45	9:15	Manure Storage and Handling	Sheffield
9:15	9:45	Odor and Dust Management	Sheffield
9:45	10:00	Mortality Management	Sheffield
10:00	10:15	Working Break	Sheffield
10:15	10:45	Record Keeping	Beddoes
10:45	11:15	Data Collection for OnePlan	Olsen
11:15	12:00	Mapping in OnePlan	Johnson
12:00	1:00	Lunch	
1:00	1:15	Livestock Inventory	Beddoes
1:15	1:30	Bionutrient Groups	Beddoes
1:30	2:00	AFO/CAFO – Runoff / Sizing	Beddoes
2:00	3:00	Cropping Section	Johnson
3:00	3:15	Break	
3:15	3:45	Irrigation	Sandoval
3:45	4:15	Resource Concerns	Fisher
4:15	4:45	Application	Beddoes
4:45	5:00	Nutrient Risk Analysis	Fisher

Thursday, September 22nd

8:00	8:15	Plan Generation	Johnson
8:15	8:30	Plan Maintenance (Building on Record Keeping)	Johnson
8:30	9:00	Working with Multiple Plans	Olsen
9:00	12:00	Complete Sample CNMP	All

OnePlan Nutrient Management Software

Developed by:

Idaho Department of Agriculture
Natural Resource Conservation Service
United States Environmental Protection Agency
USDA Agricultural Research Service
University of Idaho College of Agriculture
And
Marshall and Associates
OnePlan NMP Version 1.72 was updated
By
Information Designs, Inc.

Planner's Version 1.72 User's Guide

July 2005

371

Table of Contents

372

User's Guide Written by

Bob Ohlensehlen, University of Idaho
with assistance from
Jenifer Beddoes and Ralph Fisher Natural Resource Conservation Service

Idaho OnePlan Version 1.72 was edited and updated by
Richard Johnson, PhD,
Nutrient Management Specialist
Natural Resource Conservation Service

373

Introduction

Version 1.72 of Idaho's OnePlan Nutrient Management Software is now available for development of CNMPs and for preparation of Field Annual Nutrient Budgets. We have corrected several of the bugs that were apparent in the original version. Although we have made many improvements to the program, because of time and money constraints, Idaho OnePlan version 1.72 does not correct all changes requested by the OnePlan user base, but goes along way in making OnePlan a more user friendly program.

This version, like the original version has been developed to allow planners to develop nutrient management plans that will meet the Idaho Department of Agriculture's requirements for plans for dairy and beef producers. In addition, we have made changes in the data base that allows this tool to be used by the fertilizer industry as the Nutrient Planning tool that field men would use working with growers who participate in USDA programs.

The Idaho OnePlan Nutrient Management Planner is the only officially recognized planning tool for creating certified nutrient management plans in Idaho.

Idaho OnePlan is an extremely complex program that makes use of the latest technology in the development of plans. The mapping program takes advantage of the GIS information that has been collected by various agencies and housed at the Idaho Department of Water Resources. Users access the map via the Internet. Once the farm map data is located, it must be "clipped" and saved as a file, which is then accessed by the software. When the data is "clipped" and saved, several layers of GIS data are also saved, such as soil types and soil data, resource concerns, stream and waterway data, soil slopes, field maps, climatic data, HUC information, stream listing information, buildings, corrals and other features.

As stated in the previous version, Idaho OnePlan Nutrient Management Planner is designed for planners and will continue to be an evolving tool. As new technologies become available, our technical personnel will continue to look at programming in an attempt to streamline this highly sophisticated, technical piece of software. As with previous version many countless hours have been spend by our technical experts and software programmers in trying to improve the performance and accuracy of the data utilized in the program. We ask you continue in offering areas and items for ongoing improvements, we ask you to be patient as we work together, through the challenges that may accompany using such a complex program, to improve the performance and quality of the finished product. Again, if users can document problems or suggest improvements and forward those to the design team, these suggestions will be taken into consideration. If you encounter major glitches in the program, please contact, NRCS/ID's Nutrient Management Specialist @ 208-685-6992.

As with any program, the output is no better than the information that is provided to the program. The University of Idaho Nutrient Planning Worksheets provides an excellent start in the collection of the appropriate information (**DATA COLLECTION FORMS**

And GUIDELINES). There is no substitute for personally involving the producers in the process of development of the plans; they are "their" plans.
Discussing the input with the producers as the information is being entered will help eliminate miscommunication that might otherwise occur.

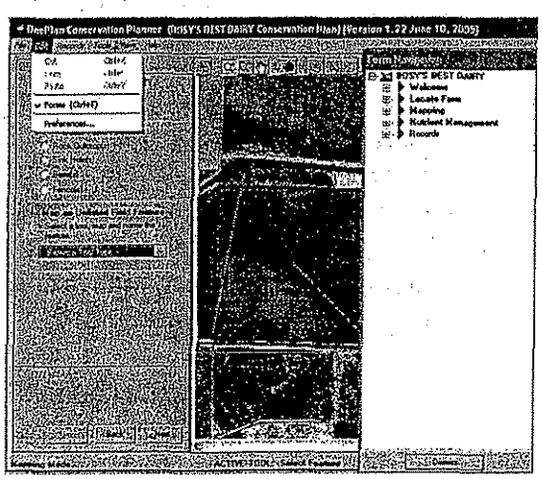
General Operating Information

Many of the features of Windows programs are also a part of the One Plan Nutrient Management Software. The program is designed to operate on Windows 2000 and Windows XP.

Progressing Through the Program – The best practice is to follow the path provided by the program, as it will request information in the order in which it is needed, however the program is now very stable allowing the user to move from one screen to another without interfering with operation of the program. Upon completion of data entry into a cell or blank, the data is automatically being stored into the appropriate database when the "next" button is pressed moving the user to the next input screen. When revising existing data, it is essential that the "next" button always be pressed to save the data and to initiate recalculations made by the program. There is no action required by the user to insure that information is stored except to leave the completed cell. (There are a few exceptions; data is stored by pressing, "Enter", "Next" or "Finished." These instances are fairly obvious as you use the program.)

Unlike many programs, when the software is closed, it remembers where you finished. When the software is restarted, the program will resume where you ended your last session.

The program is laid out in "Tabs." Each "Tab" contains a different set of information; in much the same manner as a set of "Tabs" or dividers in a notebook is used to divide groups of data into similar categories. When the user completes a section and presses "next" they are automatically moved to the section or "tab" and entered data is saved. The user can move from tab to tab by placing the cursor on the desired tab and left clicking or by accessing the "Forms Navigation (Ctrl+T)." The tree is similar to the tree found in the directory of Windows programs. Move through the tree to the desired screen and left click. When an item in the tree is preceded by a "+", the item has one or more items which are hidden. These hidden items can be displayed by "clicking" the "+". A list of items that has been opened may be re-closed by "clicking" the "-", which appears after the list is opened.



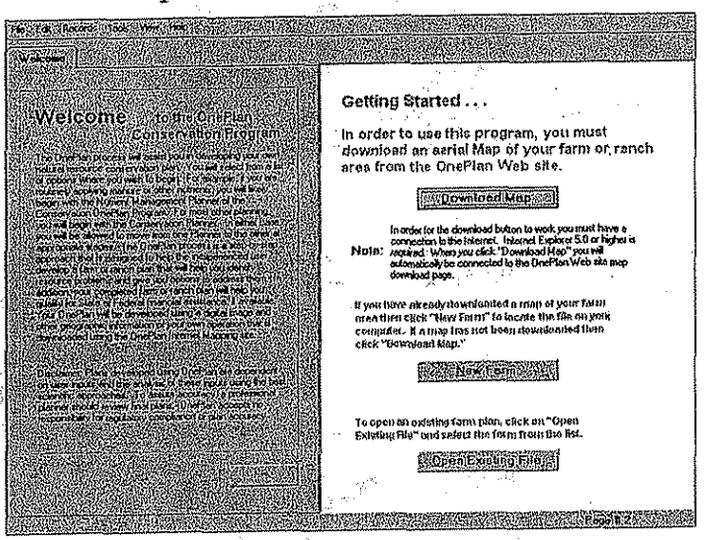
375

Buttons are used as controls in the program. Three buttons that are commonly used are "Finished", "Next", and "Back". Many of the sections of the program require the use of the "Finished" button to signal the program that you have completed the active part of the program. Generally, there is information on the screen that will make the purpose for the "Finished" button clear. The "Next" button signals the program to continue to the next screen set to request new information. The "Next" button may provide the next step of loop through similar information (for example, continue from entering data on one animal group to the next of a series of animal groups). The "Next" button may also cause the program to move from one "Tab" to the next "Tab."

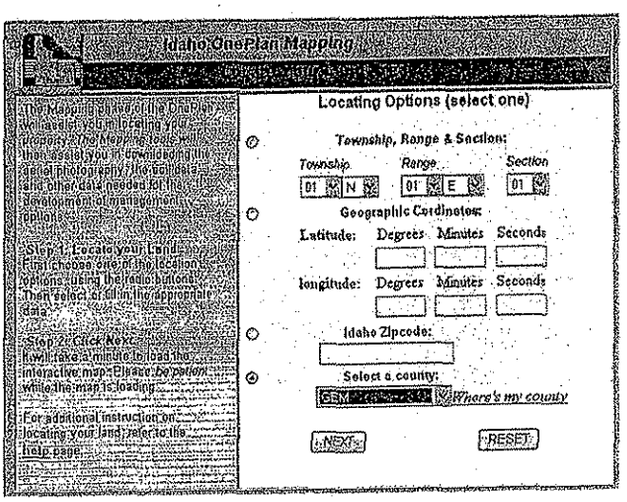
Starting a New Plan

One of the upgrades to version 1.72 of OnePlan is adding a third option to the "Welcome Tab". The planner's Welcome page has three options:

1. Downloading a new map file for creation of a new planning unit.
2. Starting a new Farm Nutrient Management Plan using the downloaded data, or
3. Opening a existing NMP file for completing a partial plan or revisiting and/or updating an existing plan.

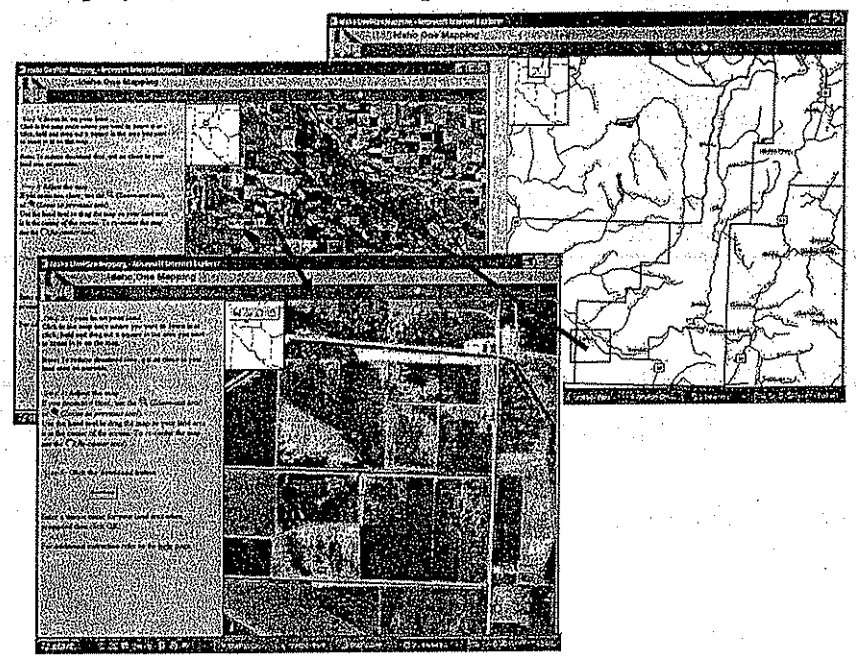


To start a new plan the user must first download a map file and its associated Soils data from the Idaho Department of Water Resources site. To create the map file for a new plan, click on Download Map" on the first page of the program. The user is automatically liked to the IDWR cite. The display at the left is the first page of that site. Once this selection has been made the user will be connected to the Internet map server where the opportunity to select the area containing the map will be available. The area can be identified by selecting a location using the legal description (which includes the township, range and section), by giving the GPS location of the property (using latitude and longitude values), by entering the zip code, or by entering the county from the dropdown listing. When the map

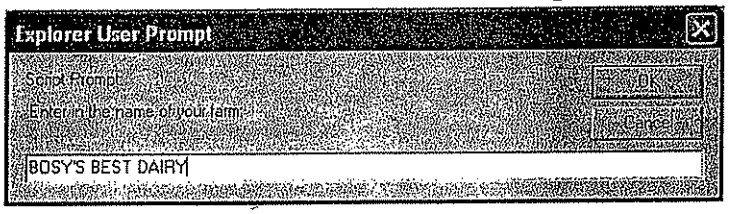


376

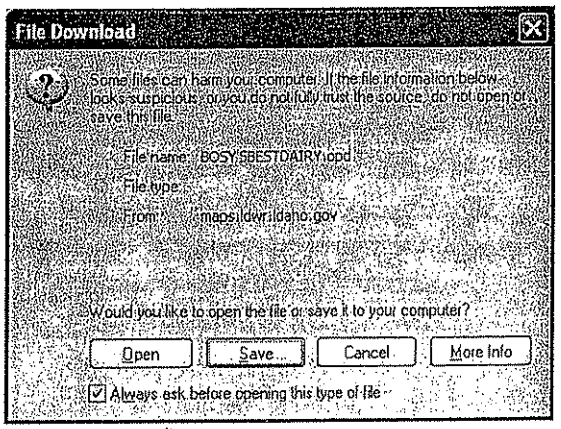
is displayed, select the smallest portion of the map that contains all of the land to be included in the nutrient management plan, up to 3 mile by 3 mile. If there is more cropland than can be included in the 1 square mile map, additional maps downloads will be needed for the additional farms included in the plan.



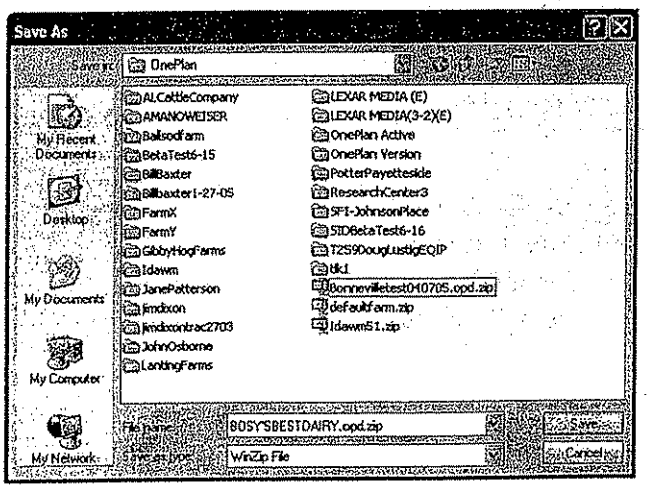
Once the desired area has been delineated, press the "download map" button. The user is asked to name the file. Give the file an appropriate name then download. The user than will be asked to either open or save the file,



"Save the file". Unless the planner selects a specific file address for saving the download, the file will be saved that the file that the last DWR download was saved.



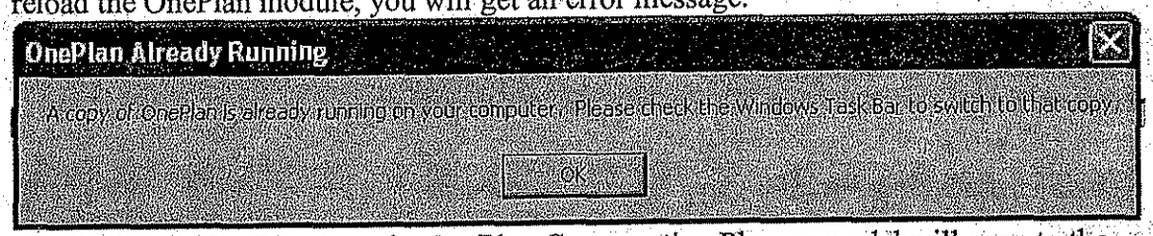
Once the Save option is selected the program then extracts the data from the Idaho Department of Water Resources Server. The extracted data is saved as a zipped file.



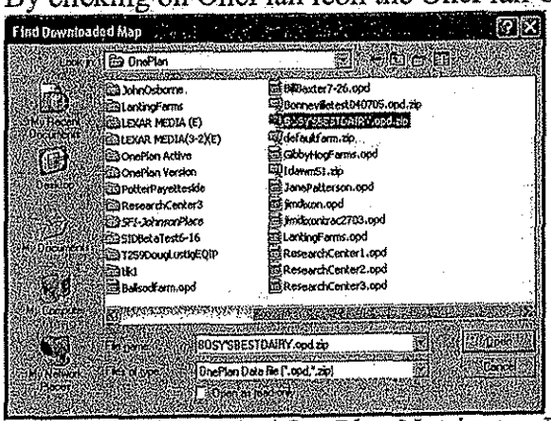
377

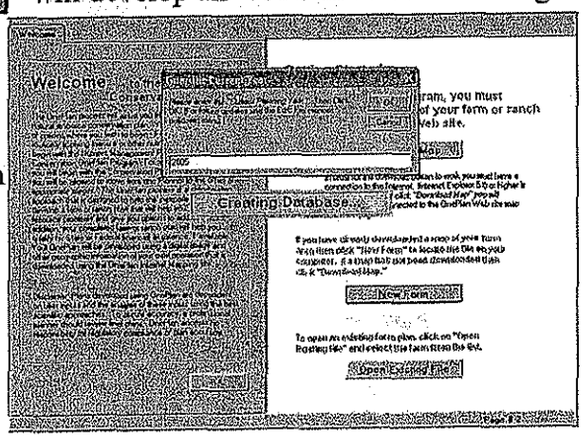
Creating a New Farm

Once the map file is down loaded from IDWR and saved, the next step will be to develop the new farm. Since the data downloading is outside the OnePlan model, NM Planner has to be activated by clicking on the OnePlan icon on the window taskbar. If you try to reload the OnePlan module, you will get an error message.



By clicking on OnePlan icon the OnePlan Conservation Planner model will open to the "Welcome Tab". By selecting the "New Farm" option, the model will ask the user to locate the downloaded data file for unzipping into a new farm data file. Two (2) operations will take place. The program will upload the database files from the OnePlan program file and download the IDWR data into the new farm database. The new farm file will be stored as a file in the C:/OnePlan folder. Secondly the program will develop an ".OPP file in the C:\Program Files\USDA\OnePlan\OnePlan Nutrient Management Planner file. The OPP file is the link that the program uses to load and store data in as an existing farm plan database. At the initiation of the new farm the user will be asked to enter the current planning year. This is critical in establishing the farm plan's base year.





Farm Plan / Data Security

Once the planner initiates a farm plan, it is the responsibility of the planner to secure the information being developed. The program will store updated data to the file where the plan is cataloged. The default file is C:\OnePlan. This file may not be secured or backed-up. To secure the file the planner needs to transfer the file to a secured file. It is recommended that the file be saved in a created file, "OnePlan" on the shared drive. The reason being if more than one planner is working on the file, then the data can be shared. Remember if more than one planner is working on the file, work together and share that you have the file open. Following the transfer, use the "Catalog Existing Plan" tool

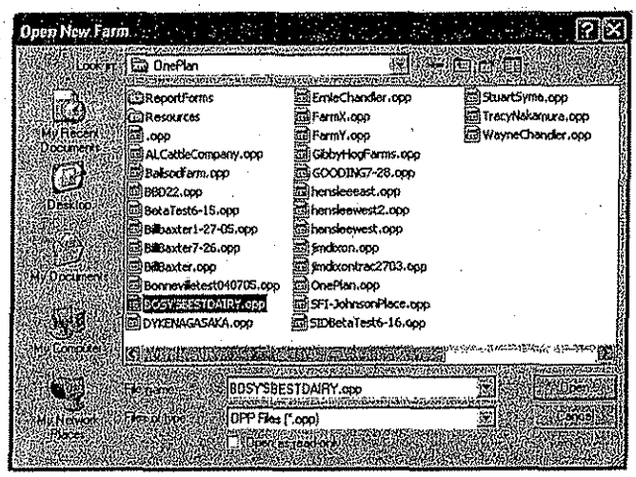
378

by opening the "Tools" tab. The program will open a new window "Choose Database for OPP Creation". The planner is asked to locate the file where the data for the saved NMP was stored.

Once you are finished working on the file, then "Close" the file using the "File" tab. This will insure that the updates of all planners working on the farm plan are properly saved.

Once the farm plan is completed. Move the plan file to the grower's file on the "Customer files on the F:/ drive. This is the most secured site.

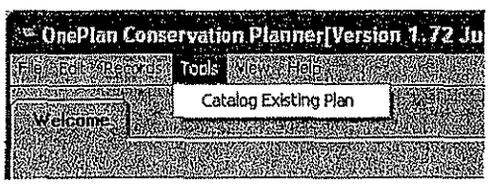
Opening a Existing Plan

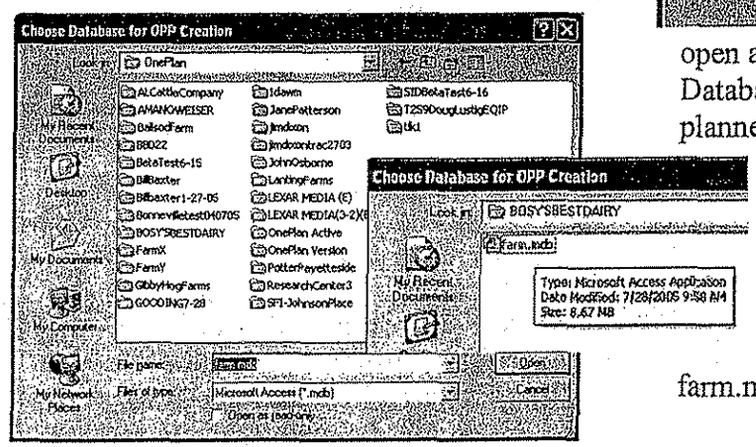


The third option on the Welcome page is the option to "Opening Existing File". This option is used when the planner wants to reopen an existing plan closed file for completion, revision and updating. Upon selecting the "Open Existing File" an "Open New Farm" window appears. The window lists all the existing plan .opp links for files that are currently recognized by OnePlan.

What if I do not see my saved file?

If you see the file you want opened simply highly and open the file. If you do not see the file the planner can use the "Catalog Existing Plan" tool by opening the "Tools" tab. The program will





open a new window "Choose Database for OPP Creation". The planner is asked to located the file where the data for the saved .NMP was stored (generally in a file on the C:\ drive). Once the date file is located the planner will highlight the file, which open and lists the farm.mdb file for the NMP.

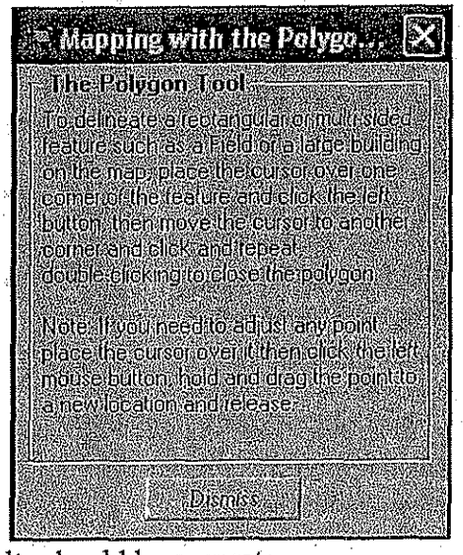
379

The planner will highlight the .mdb file and a window will open stating that plan has been cataloged to the OnePlan file and now can be opened with the "Open Existing Plan" procedure.

Mapping

As previously mentioned, the map data must be "Clipped", or downloaded from the map source found on the Internet and saved as a file. The view to the left is an example of the map feature that you will use. Notice the tools on the tool bar. Selecting the tool allows the user to zoom in on the map by clicking in the map after the tool is selected. Likewise, selecting the tool and clicking in the map will zoom out on the map. The tool allows the user to move the map in the window. Selecting the tool and then clicking in the map window while dragging in the desired direction results in the movement of the map. Once the map has been loaded as part of the program file, the first step is to outline the fields.

Important – fields must be outlined first using the polygon tool. See the following help box for instruction on outlining the fields. Note that each corner or turn in the boundary must be clicked. Note that the points that are clicked can be modified or edited by left clicking on the point and dragging the point to the new location. Notice that the area of the field as outlined is calculated and reported in acres. The calculated acreage cannot be over-ridden; however, if the outline results in too large or too small an acreage, adjust the size of the perimeter to create the correct acreage. Remember that features such as rock outcrops will be automatically subtracted from the acreages when they are identified on the map. The tool to calculate the acreage is very accurate, so if care is taken when outlining the fields, the results should be accurate.

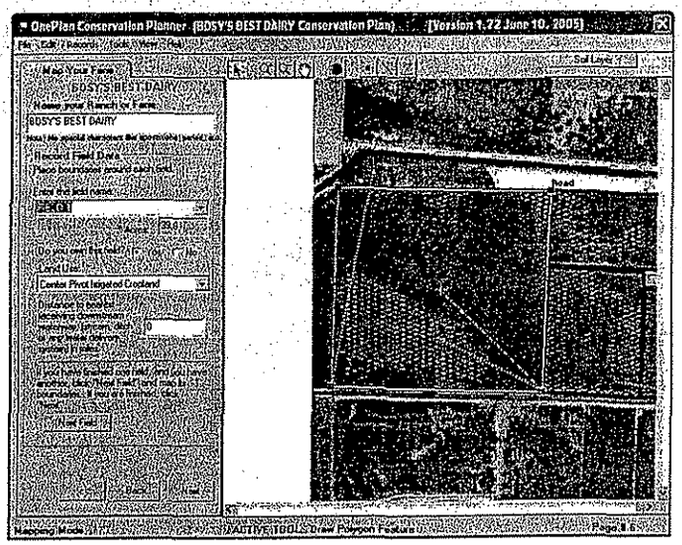


Important. OnePlan "applies" waste to fields in the order that they are digitized, therefore they must be digitized in that sequence if that is important to the producer.

380

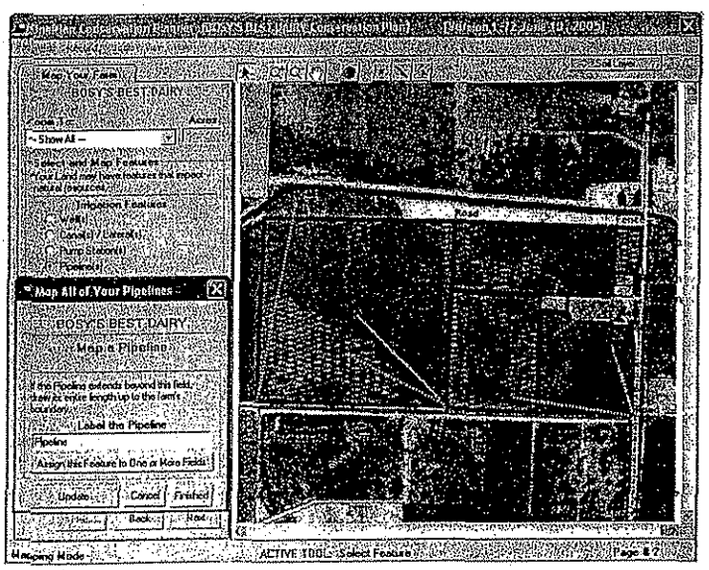
Mapping Features – Irrigation - Hydrological

Once the field has been identified, name the field in the place provided in the "Enter the Field's Name" box. Notice that once the field is named, the field is labeled on the map with the name and acreage. The next step is to identify if the field is owned and



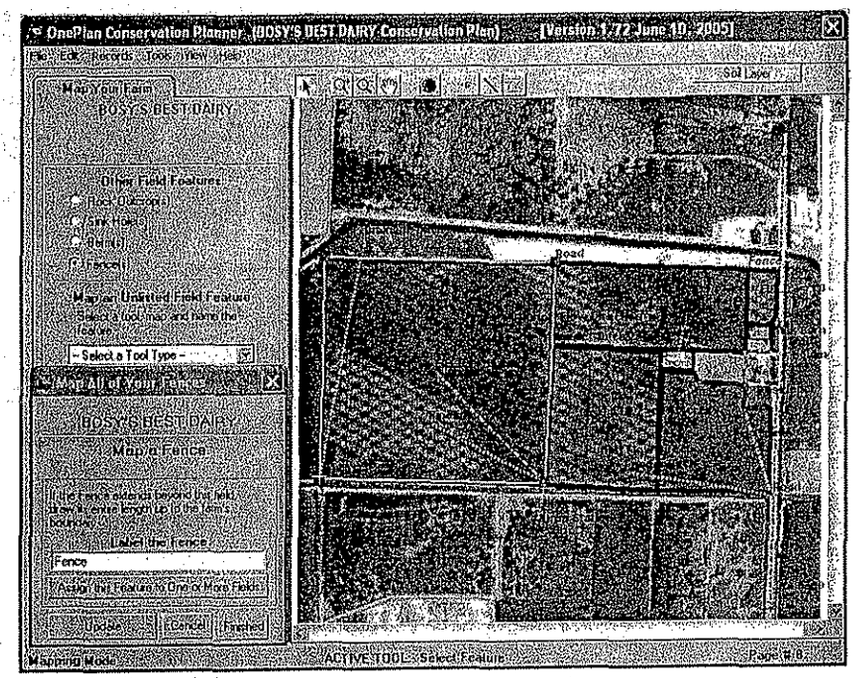
to identify the appropriate land use by selecting one of the appropriate choices in the drop down boxes. Enter the distance to the nearest downstream waterway. Distance is entered in miles, therefore if the distance is half a mile enters .5. If this field is left blank the program assumes the worst case scenario and assumes the field discharges directly into a water body. When finished, press the "Next Field" button, which will give the user the opportunity to trace a new field. The user will repeat the process until all fields are entered. When all of the fields have been entered, press the "Finished" button and then the "Next" button to proceed to the next "Tab" or part of the program.

The next stage of mapping requires that the user first select the field for which additional Information is being provided. Once a field is selected, the Irrigation features and Hydrological features that apply to the selected field are mapped. When a feature is selected, an appropriate drawing tool is activated for the user to identify the selected feature. To map features for a different field, select the desired field by selecting the correct field from the drop down box at the top of the information column. When all fields have been mapped, press the "Next" button to move to the next "Tab".



381

Other Field Features

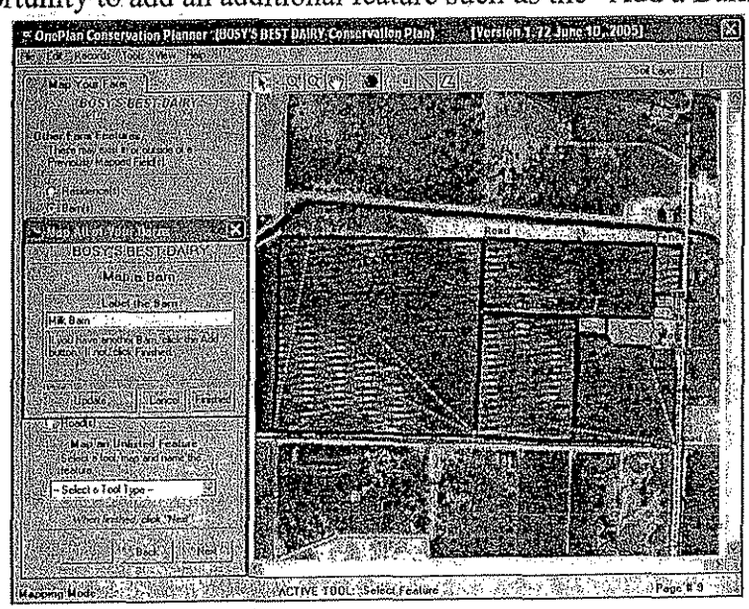


When "Other Field Features" are selected the overlaying window seen to the left appears. The user must then draw the feature on the field and can quit by clicking "Finished" and select a different feature. The user can press the "Add an Outcrop" button to add additional rock outcrops to the field or may select another field to add an outcrop.

Important – clicking on the boundary of a feature and pressing the "Delete" key on the keyboard will remove a feature. Once a feature is deleted, the label associated with it will not be removed. There is no way to remove labels once they are on the map.

Other Farm Features

Mapping other farm features is very similar to other mapping features. Simply select the feature you wish to include and a window that identifies the feature will appear. You will have the opportunity to add an additional feature such as the "Add a Barn" as seen at the left or you may



Press "Finished" and return to select another feature or to continue. You can select the appropriate drawing tool for the feature you are entering. Lagoons are found under the category of liquid manure handling. Solid manure and feed storage are found under storage areas or facilities. Fields or labels for digitized labels can be moved once they are digitized. The program will frequently lay one label over the top of another making it impossible to read unless it is moved.

382

Editing Fields and Features

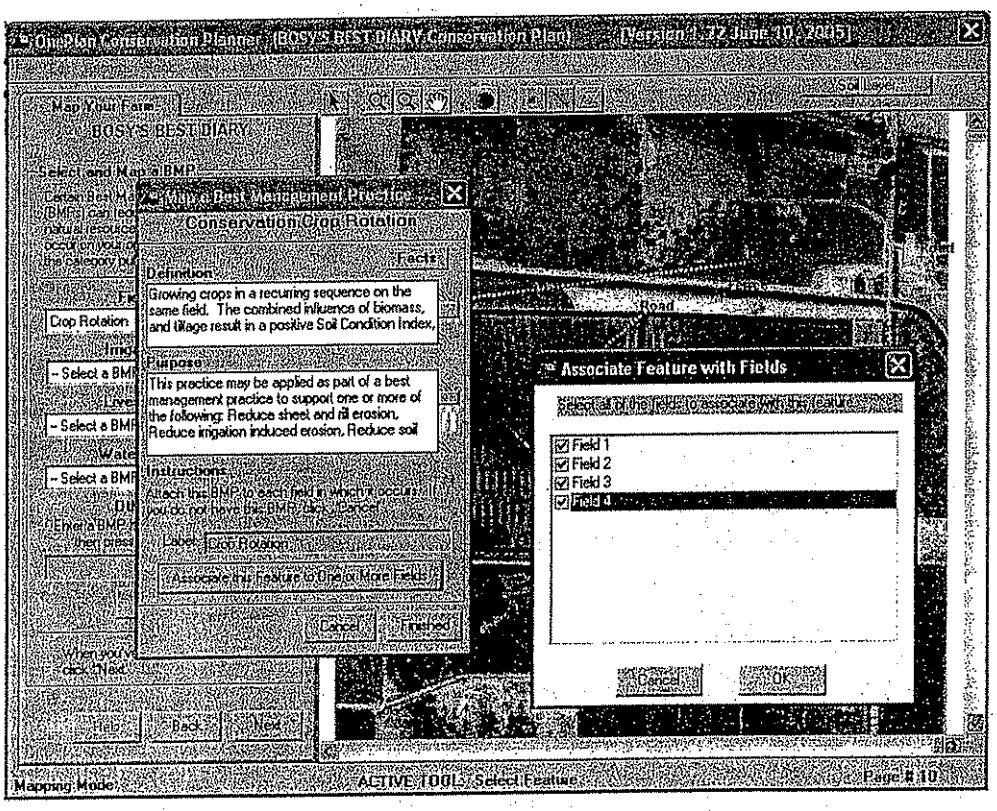
To delete a field: Go to the "Map Your Farm" Tab "Record Field Data" screen and select the field to be deleted. Click on the field then press delete.

To delete a digitized feature: Go the screen where the feature was originally digitized. Click on, or select the feature that will be deleted to activate the dropdown box. Activate the "Pointer" tool on the tool bar. Left click on the feature to be edited to make it active, press delete.

To move the label for a digitized feature. Go the screen where the feature was originally digitized. Click on, or select the feature to be edited. Click on the "Pointer" tool on the tool bar. Move the cursor to the feature that will be edited and left click to make it active. Move the cursor to the location where the label is to be moved to and right click. The label will be moved and a line drawn from the label to the feature to associate it.

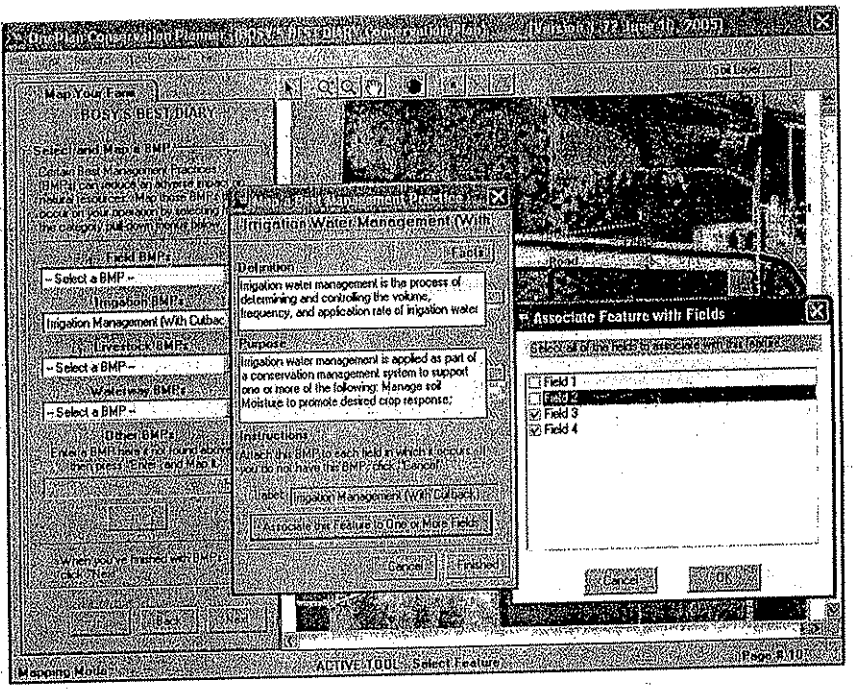
Field BMP's

Select the Field BMP that applies to your farming practices. Next select the field and attach the BMP to the field by checking the small check box to the right of the field name. The label will be applied to the field.



383.

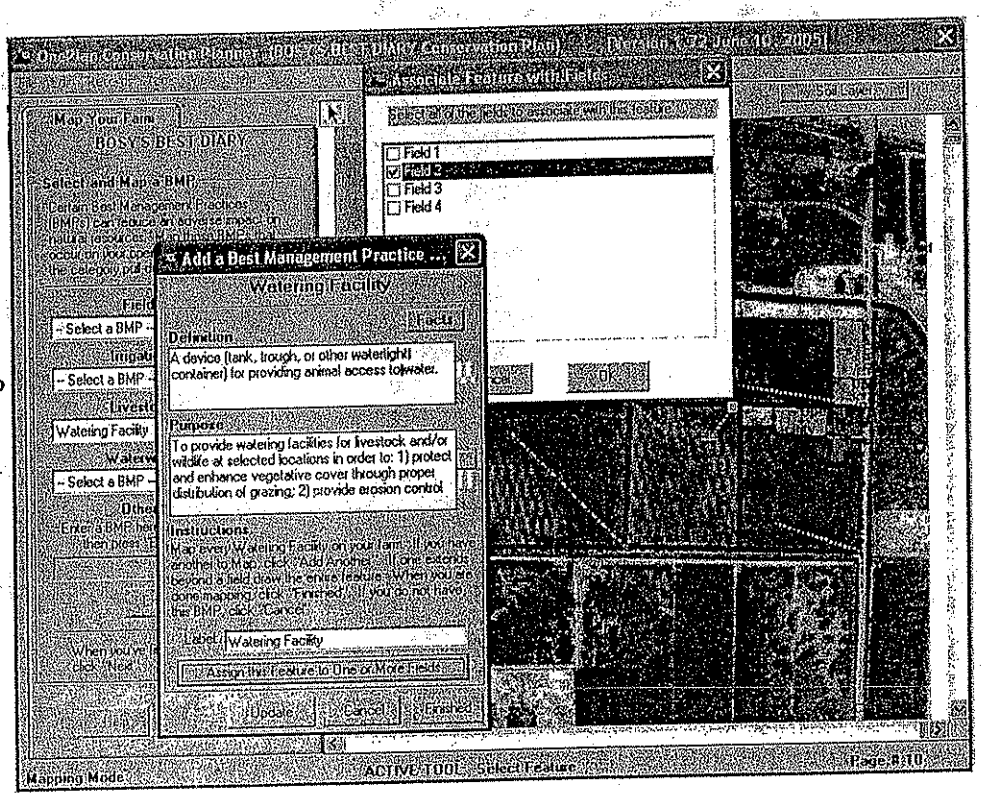
Irrigation BMP's



Select an Irrigation Water Management with the desired field selected. When the field and BMP are selected, check the box to attach the BMP to the field.

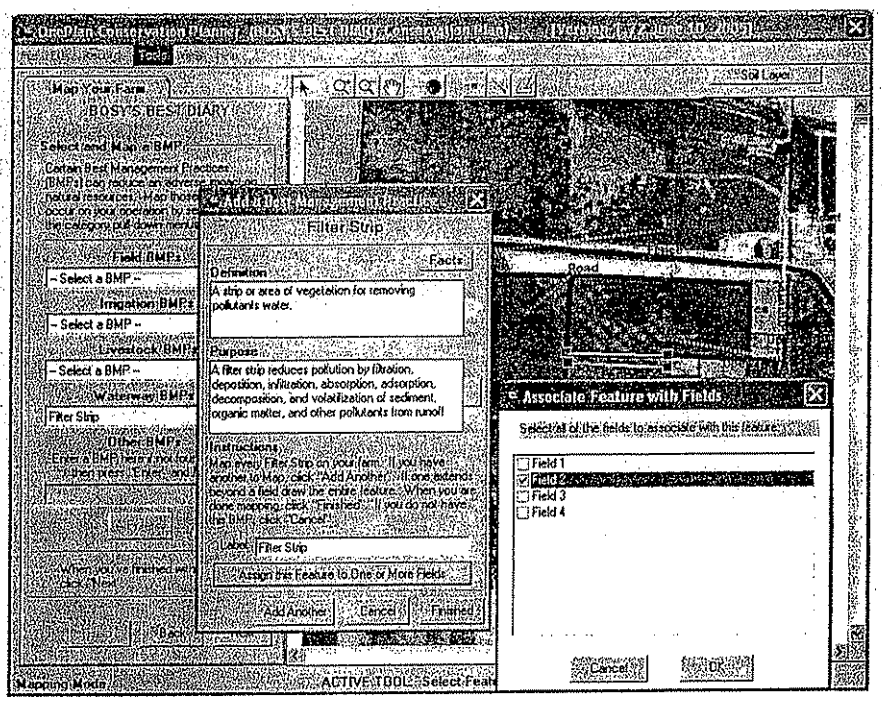
Livestock BMP's

Select a Livestock BMP with the desired field selected. When the field and BMP are selected, check the box to attach the BMP to the field.



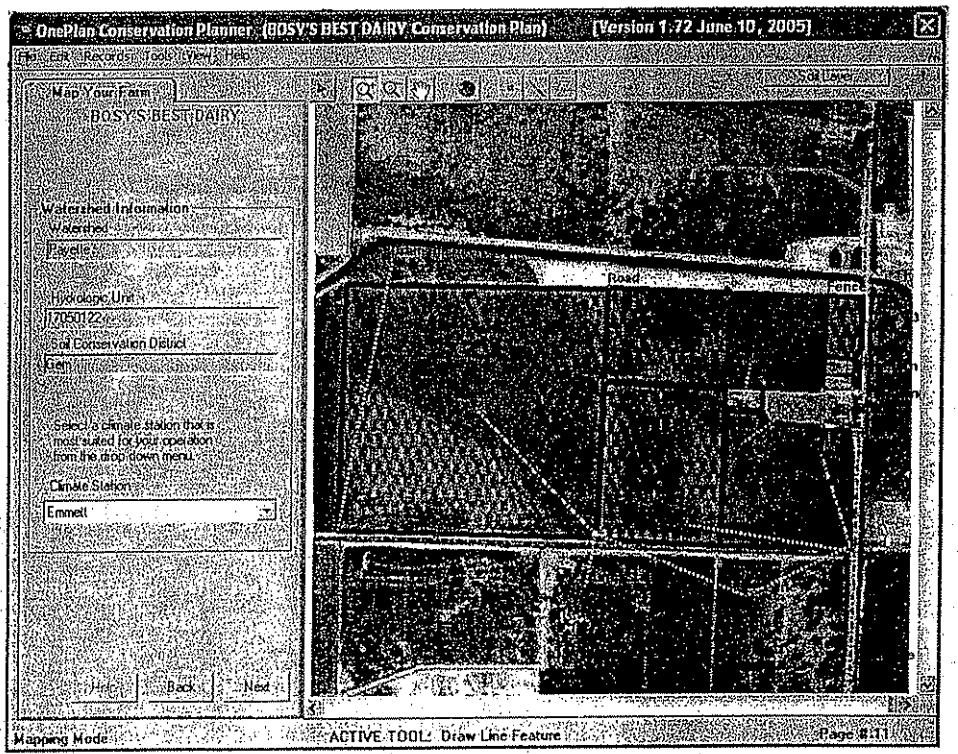
384

Waterways BMP's



Select a Waterway BMP. The waterway BMP's usually extend across field boundaries so they are not specifically attached to a field but are drawn on the field or fields where appropriate.

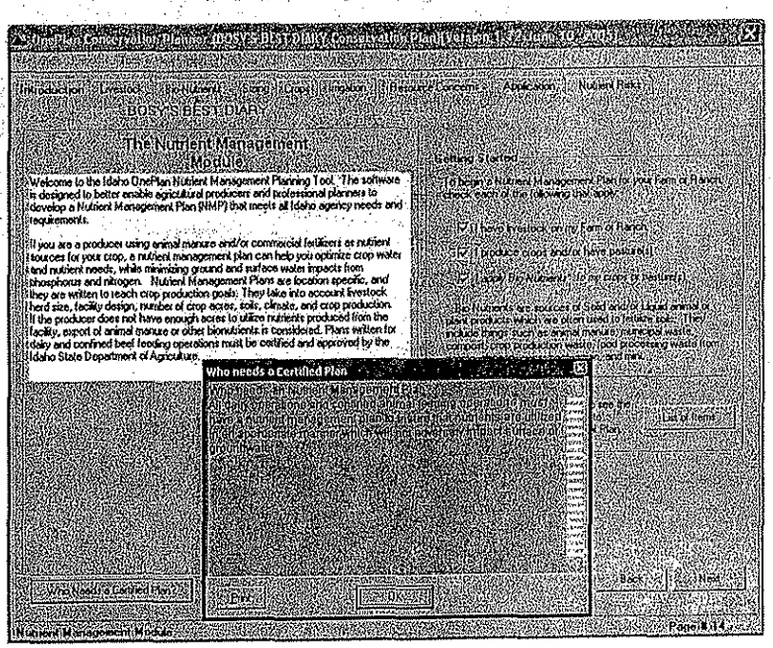
Assigning Watersheds



Once the waterways are completed the program will advance the user to the next Tab, which brings the data from the GIS layers. The watershed or HUC, including the HUC Unit number, is automatically populated in the cells. The soil conservation district is also placed in the file. The user is asked to select the climate station. The appropriate climate station or a station that most closely resembles the amount of precipitation at the facility location should be used.

285

Nutrient Management Module

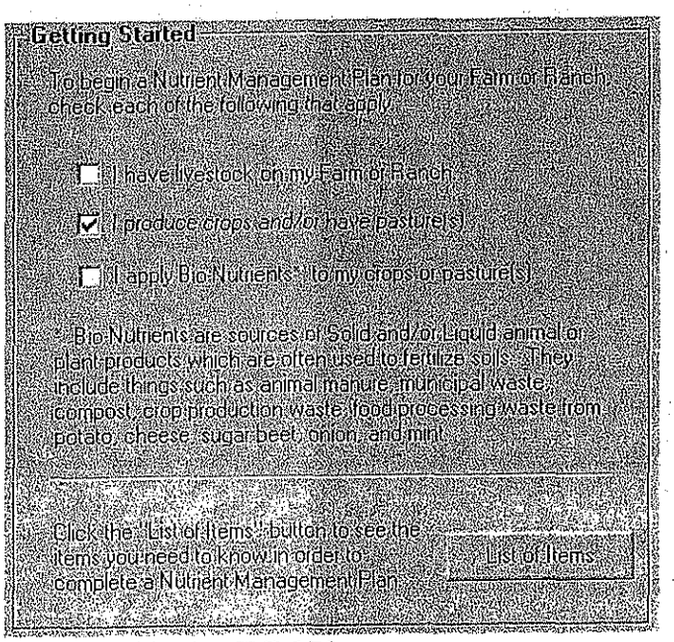


The "Who Needs a Certified Plan?" button at the lower left hand corner of the screen will provide a brief overview for the user to help them determine if they do, in fact, need to develop a plan.

Getting Started (Commercial Fertilizer or Biosolids)

The Nutrient Management Module contains the "Tabs" that will be used to collect the information necessary to complete the preparation of the nutrient management plan.

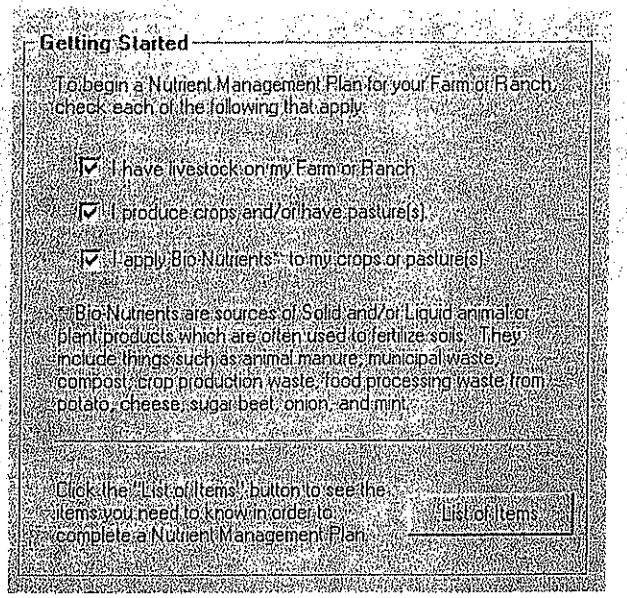
NMP for Commercial Fertilizers



The NM Module can be used for development of Comprehensive Nutrient Management Plans (CNMP) that can involve application of biosolids (animal waste) and/or commercial fertilizers. If the NM model is used for development of only commercial fertilizers, then the planner will check the "I produce crops and/or have pasture(s) option. These actions will by-pass the Animal Waste tabs in the model and take the planner to the cropping "Crops" tab. Once the CNMP has been developed for the farm then the module can be used to develop Annual Nutrient Budgets for each field included in the CNM Plan.

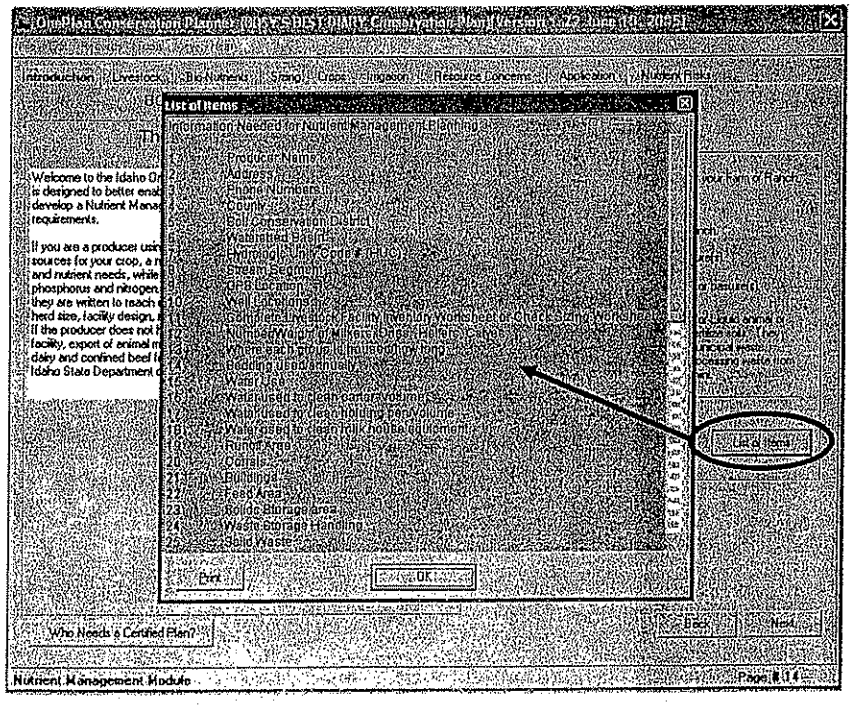
386

NMP for Biosolids



Once the situation has been defined by selecting the appropriate responses in the check boxes as displayed in the screen to the left, the necessary "Tabs" will require the user to input information for the required "Tabs" before completing the plan. The "Tabs" in this part of the program will require input for livestock, bio-nutrients, sizing, crops, irrigation, resource concerns, application and nutrient risks, depending on the situation for each farm.

List of Items Required to Complete a Plan

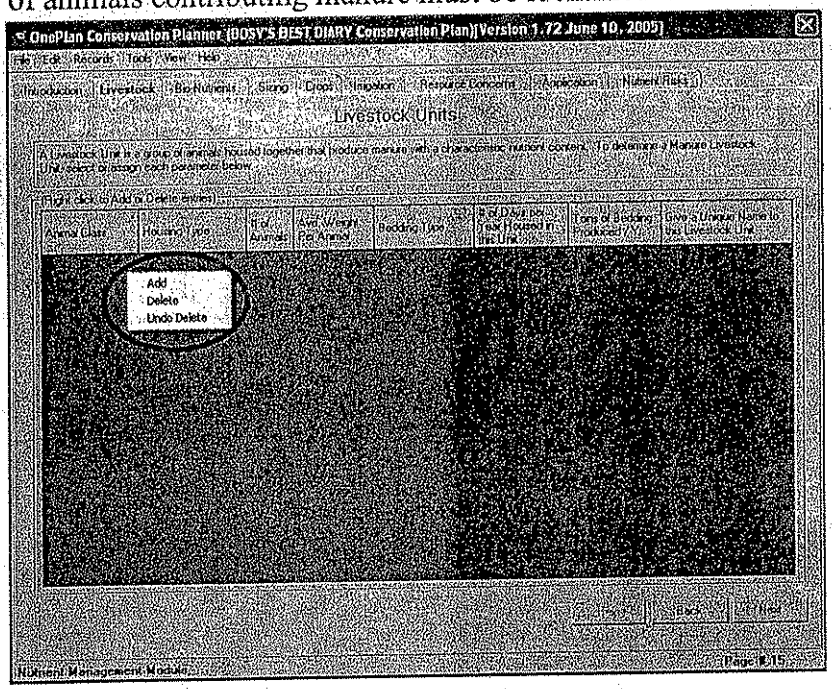


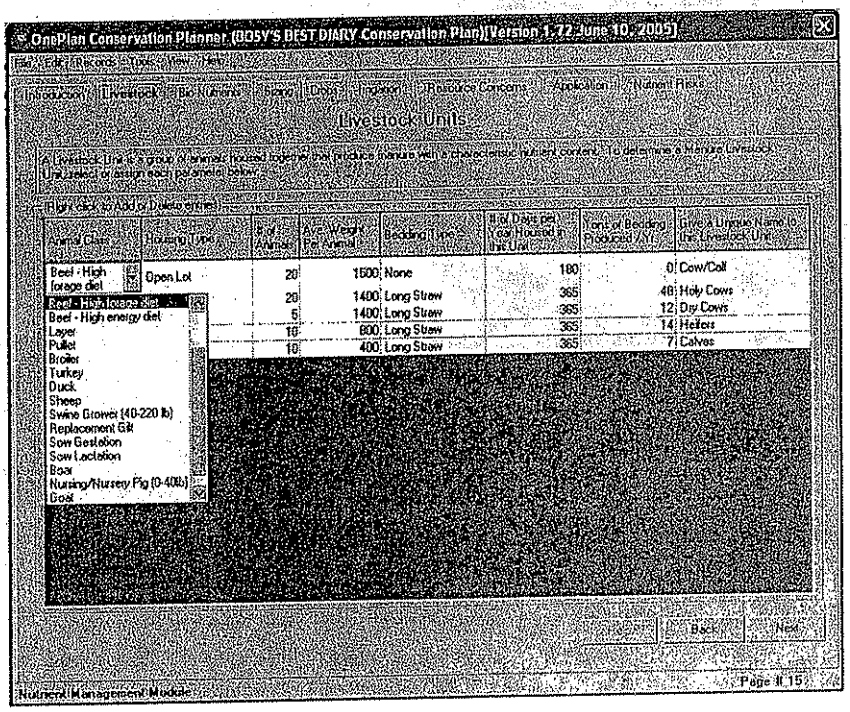
The introductory window for the nutrient management module has a button that when pressed will display a list of items that a producer or planner will need to have to complete a plan. The list can be viewed on the screen or it may be printed for reference.

387

Determine the Livestock Units on Facility (when Livestock Tab is selected)

Livestock units or manure production units are those groups of animals that contribute manure to the total amount of nutrients to be applied on owned land or exported to other farm land. The different groups of animals contributing manure must be identified individually by completing the "Livestock Unit Parameters" information at the top part of the page. To add a livestock unit move the cursor to the grayed area of the Livestock Units page and right click to activate the add, delete, or undo delete drop down box. Click the add option to add the livestock unit.



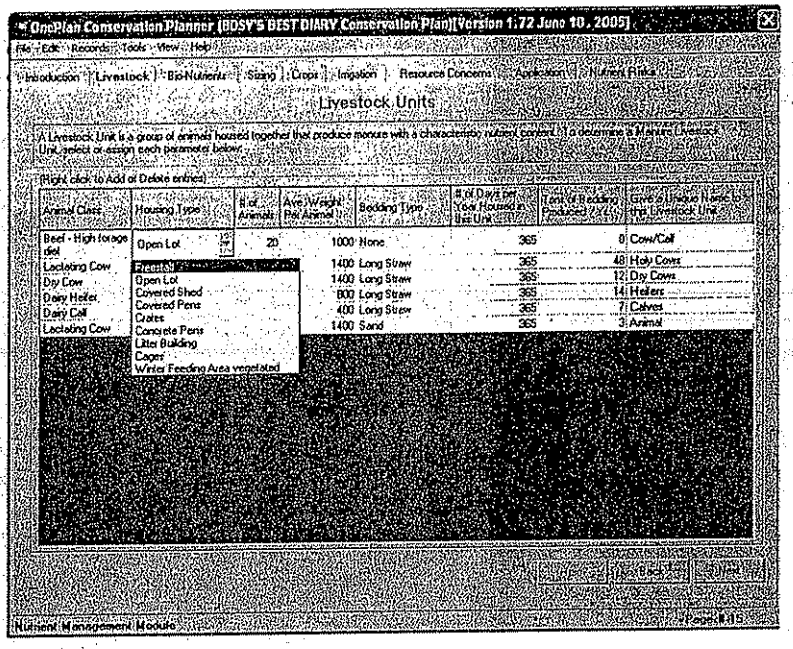


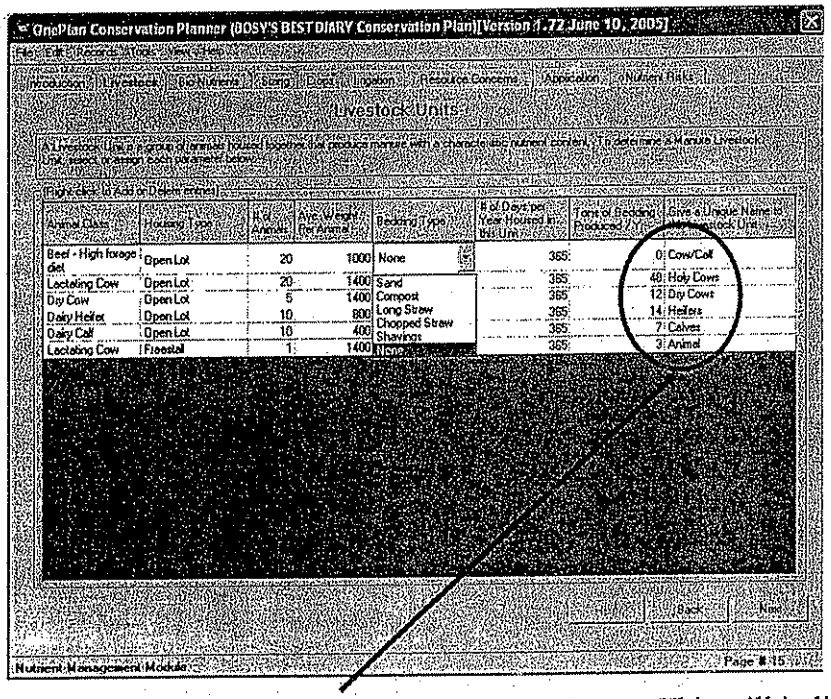
Several of the requested inputs utilize drop down boxes such as the "Animal Class" box shown below.

The user must select one of the choices in the box by moving the cursor up or down to the chosen selection using the arrow keys or by "Left Clicking" the mouse on the proper choice.

388

Continue by providing the requested information in the remaining boxes.



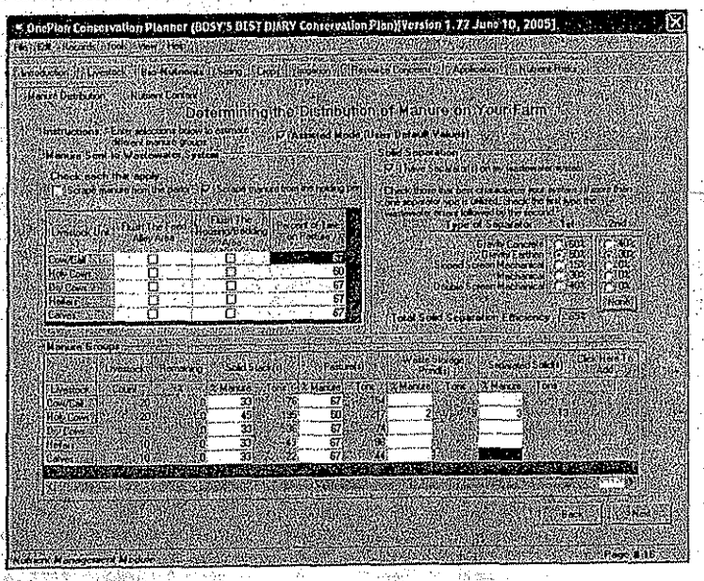


NOTE: Bedding type is an optional entry, but if it is not entered, the nitrogen values will be inaccurate, as there is no compensation for the nitrogen tied up by the incorporation of the straw in the manure. Animal weights can be overridden.

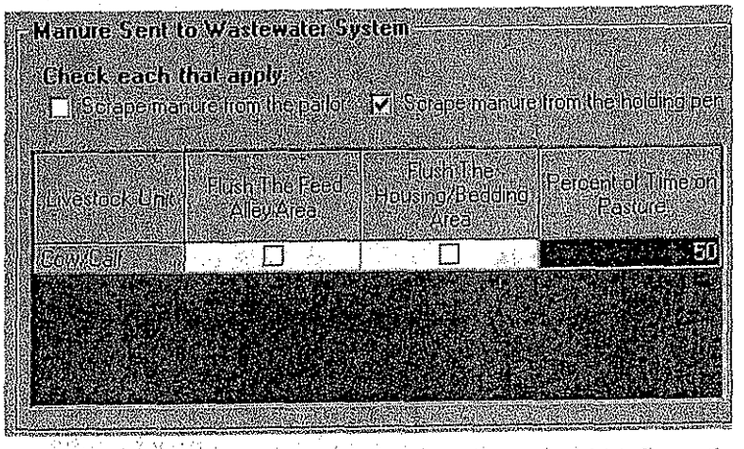
NOTE: Give the Livestock Unit a Unique Name. This will individualize each Livestock Unit. To delete a group, highlight the group you wish to delete, click the right button on the mouse to activated the Add, Delete, or Undo Delete drop down box and left click the mouse to finish the delete. To complete the Livestock Unit, press the "Next" which stores the "Livestock Units".

Determining Manure Distribution on the Farm

Manure is produced and stored in a variety of ways on livestock operations. Some manure is stored as liquid, while other manure is stored as a solid and some manure is deposited directly onto cropland when animals are pastured for all or part of the year. On those facilities having a solid separator to remove part of the solids from the liquids so that they may be handled as dry manure, separated solids are created. The storage and handling of each of these types of manure affect the nutrients that are retained for crop usage. When the livestock units were defined in the preceding "Tab" the amount and nutrient value of the manure was determined.

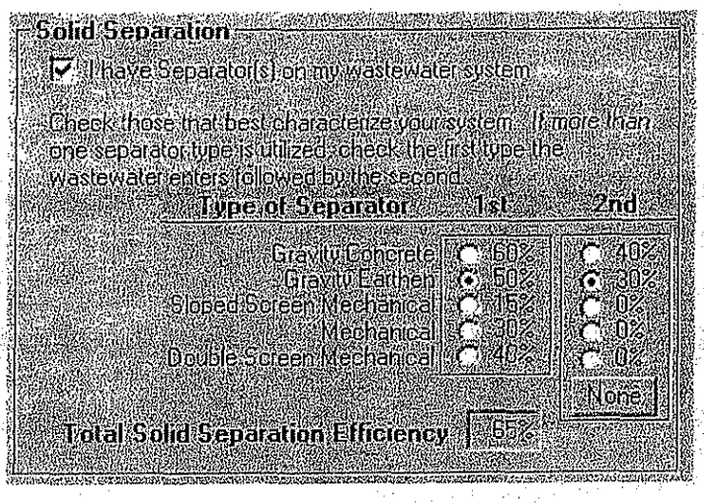


It is now necessary to determine where the manure will be deposited and stored. Note the check box at the top of the page the allows the user to select to use the "Assisted Mode." This mode will utilize a set of default values for the manure distribution. Advanced users or special situations may require use values that are different from the defaults. To use this feature, remove the check in the box by "left clicking" in the box.



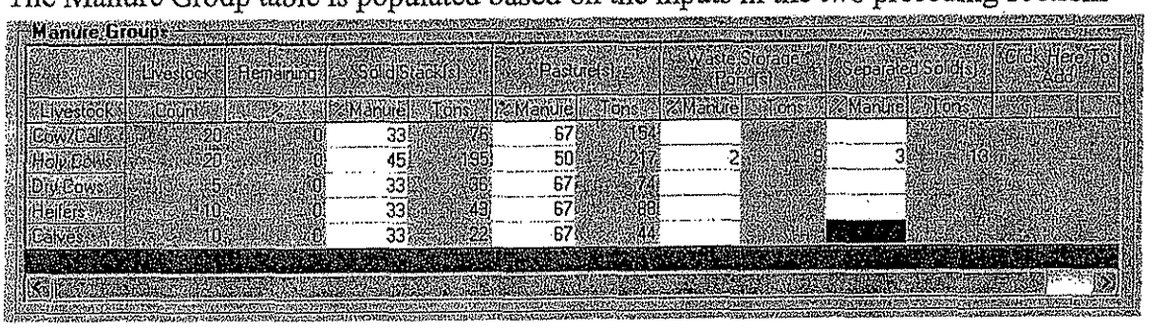
The Manure *Distribution* Screen is divided into three parts. The first part requires the user to identify what part of the manure is being handled with water. The check boxes at the top allow the user to identify if waste in dairy operations is being scraped from the parlor and holding pen. The program estimates the amount of manure on a dairy operation to be 10% from the parlor and 5% from, the holding pen. If either is being scraped, the amount of manure entering the liquid stream is reduced to 0% for the value where scraping is being done. When the boxes in the "Flush Feed Alley" or "Flush The Housing / Bedding Area" are checked the amount of manure entering the liquid waste stream is increased accordingly. When animals are pastured, the number of days on pasture is used to calculate the amount of manure that is removed from the solid and liquid manure being stored in the system.

390



Once the amount of manure entering the liquid waste stream is calculated, planners can elect to calculate the amount of separated solids that are removed when solid separation is a part of the waste handling system. Planners have the option of using either 1) no separation, 2) one separator, or 3) a combination of separators. Once the separator or combinations of separators have been selected, the program will calculate the expected amount of solids that will be removed from the liquids. The amount of separated solids is also reported and will need to be included in the plan for applying or exporting nutrients.

The Manure Group table is populated based on the inputs in the two preceding sections

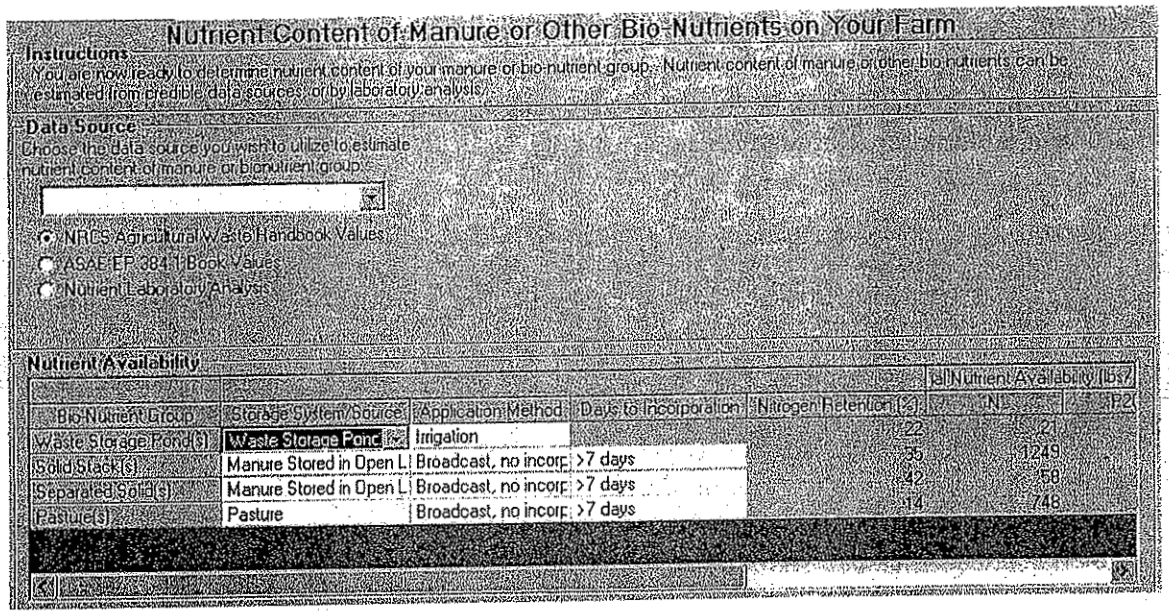


and by the inputs from the Livestock Units Section. When the "Assisted Mode" is not active (not checked) planners can use their own values in the % manure columns. Caution should be taken when using other than default values to be certain the differing values are warranted. Using other than default values should be documented in the plan summary.

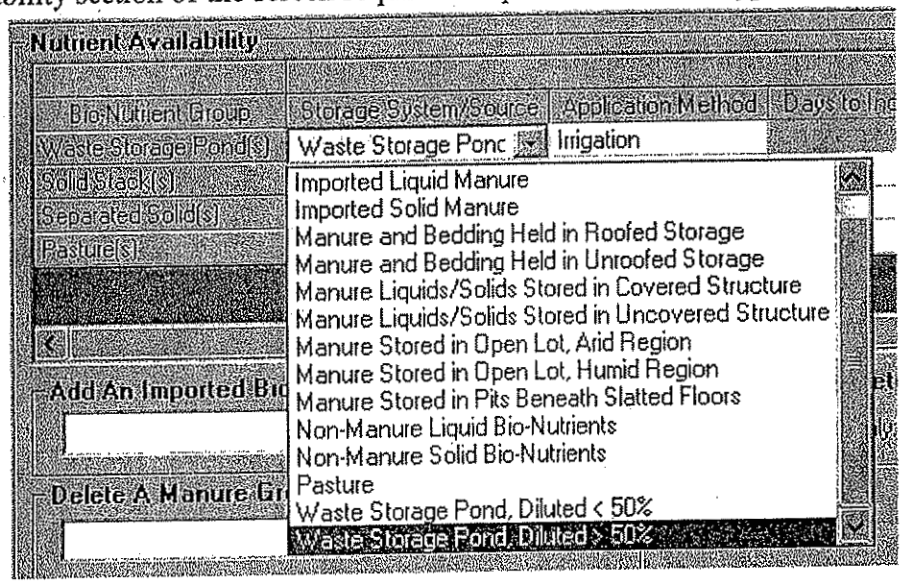
Nutrient Content and Other Bio-Nutrients

The program estimates the amount of nitrogen loss that occurs based on the type of storage and the method of application. In this section, the planner will be required to enter information that describes the handling of manure in 1) waste storage ponds, 2) solid stacks and 3) separated solids. Storage, handling and application all have an impact on the amount of nutrients retained for crop production.

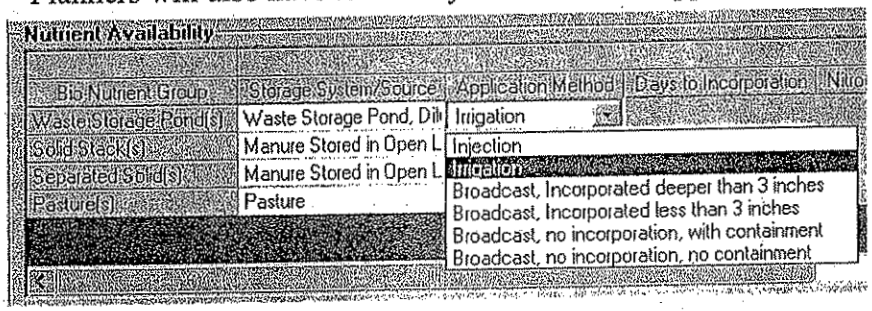
391



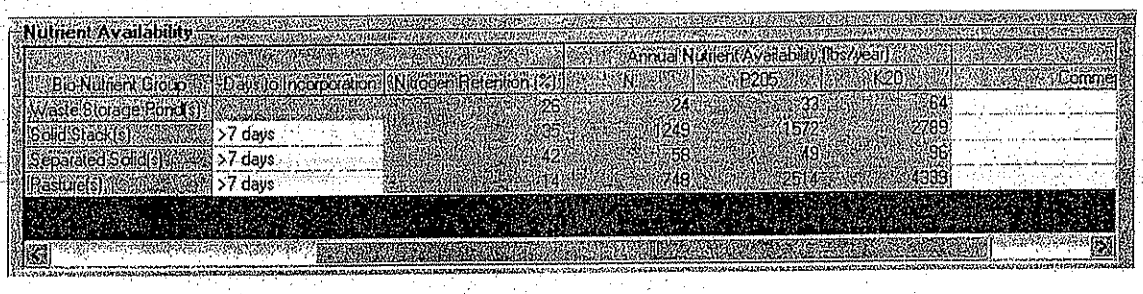
The Nutrient Availability section of the screen requires the planner to define type of storage is being
Used for each of the types of manure being stored. Storage types will dictate the amount of nitrogen that is lost during the storage period.



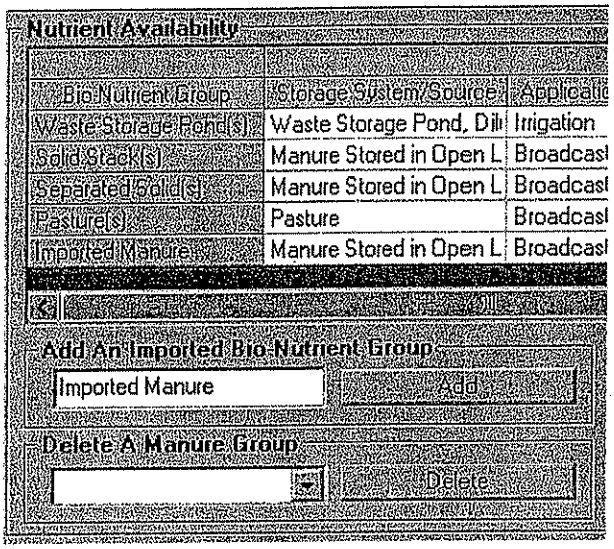
Planners will also have to identify the method of application that is being used for each of the manure groups. Application methods have varying values for loss of nutrients.

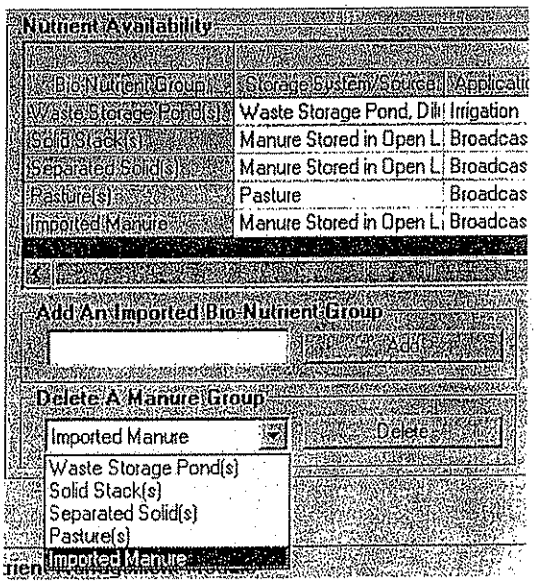


The planner's final action is to determine the days between application and incorporation of the manure group. The result of profiling the manure group storage, application and length of time for incorporation determine the pounds of N, P_2O_5 and K_2O that will be available for crop production.



When it is necessary to add an imported bio-nutrient group, the planner can simply name the imported bio-nutrients by entering the appropriate name in the space provided and press the "Add" button.

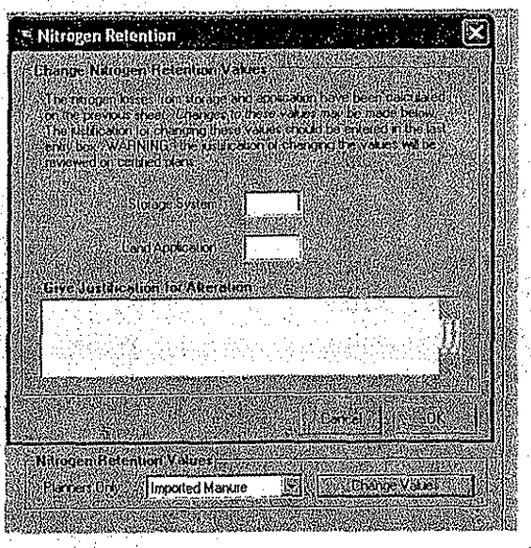




Should it become necessary to remove a bio-nutrient group, the planner can select the appropriate group from the drop down list and press the "Delete" button to remove the unwanted group.

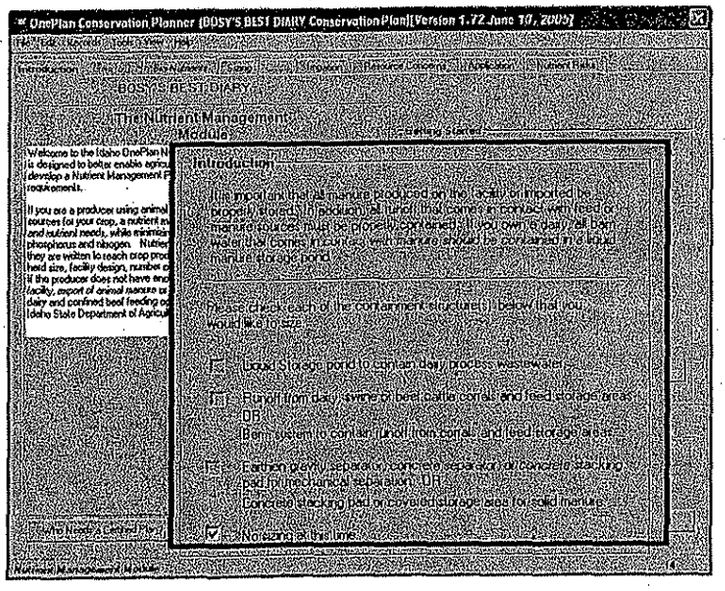
393

When a special situation occurs where the default values for nitrogen retention are not appropriate the planner can input his/her own values. When a change is necessary, select the manure group and then press the "Change Values" button to access the screen as shown on the right, which allows entry of the new? value. **Note** that when changing the default value, the planner must give a justification for the change being made. This justification will be noted on the final printout. Remember that a change in the value must be justified and approved by the Department of Ag.



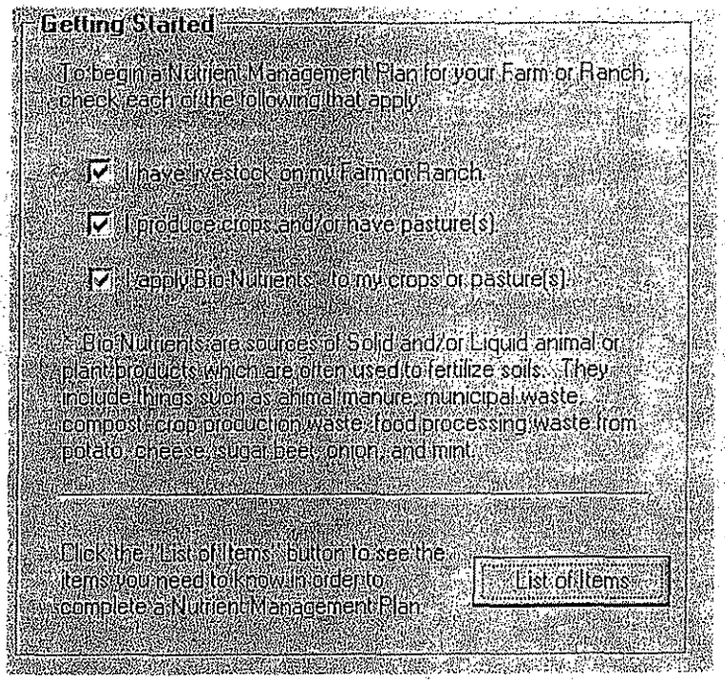
Animal Facilities Sizing

The sizing module is intended for those facilities needing a sizing of storage facilities for process water, runoff, solid manure storage or a gravity separator. If the planner is preparing a risk assessment only on the manure produced on farm, manure exported off farm, or manure import on farm he/she can opted not to develop the facilities storage facilities needs. To activate this option the planner will check the "No sizing at this time" option.



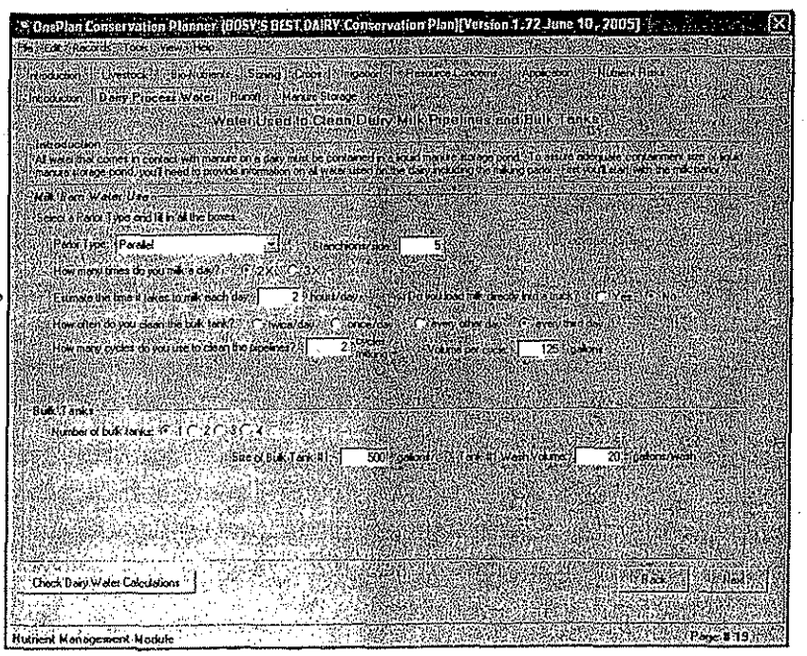
If multiple species are a part of the operation, process water entry will be required for each of the animal species. The "Tabs" for each of the species asks for appropriate information regarding the process water used by the various types of production and management practices used with the selected specie. Planners can select to perform sizing

394



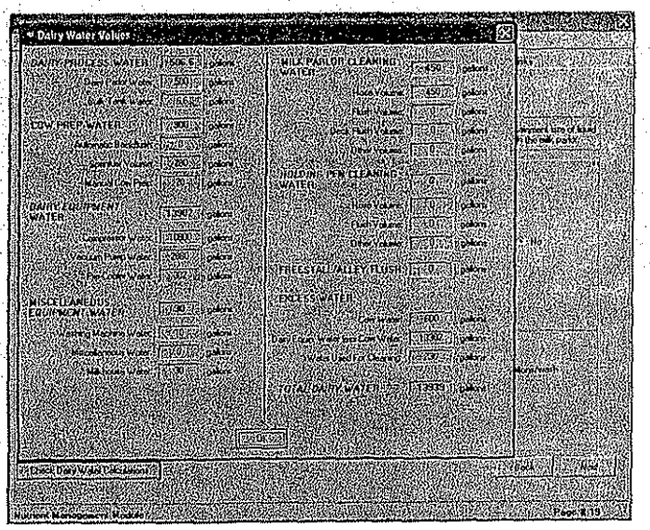
operations, if needed, for liquid storage ponds, runoff areas where there is manure and from feed storage areas.
Additionally, planners can use the software to size separators and storage areas for separated solids or scraped solids. The user can choose to send corral runoff to either a lagoon or to contain the runoff using a runoff containment berm.
The module will provide a means for the user to select the appropriate components and to determine the correct size based on the animals contributing process water and runoff.

Water Used to Clean Pipelines/Bulk Tanks



The initial input requires the entry of the parlor type, which is selected from a drop down box. The user must enter the number of cows per side in the parlor, in the case where there are multiple parlors in the barn, use all cows in the barn when full and divide by 2 to get the appropriate number of stanchions per side. The number of hours used per day is used in the calculation for water and should represent actual milking time. The question regarding direct loading of milk will eliminate the need for the entry of water use relative to the bulk tank. For smaller herds where milk is not shipped daily, the radio buttons to indicate frequency of shipment are used to factor the amount of cleaning water for the bulk tank. The number of cleaning cycles for the pipeline combined with the volume information is used to calculate the total amount of water

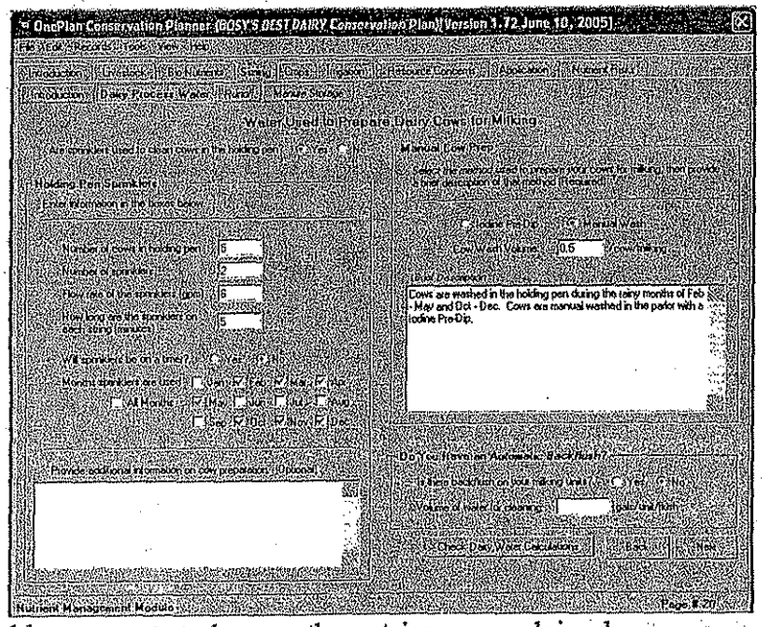
used for cleaning the pipeline. When entering the number of bulk tanks, press "Return" to get the entry windows that contain the input cells for bulk tank water requirements.



Note: The "Check Dairy Water Calculations" button provides a summary page that displays all of the various water uses in the dairy barn. It is quite handy to review all of the sources of water that have been entered up to that point. When the "Dairy Process Water" tab is selected, the user will be given the opportunity to provide the necessary input, which will be used to determine the size of storage needed to meet all state requirements.

Water Used to Prepare Cows for Milking

The second entry screen for entering the "Dairy Process Water" information deals with the preparation of cows for milking. The use of a wash pen requires the entry of the appropriate information for determining water use. The number of cows in the holding pen is used to calculate the number of times the holding pen will be used on a daily basis. Enter the total number of sprinklers that will be used to wash the cows. If it is unknown, consult with the equipment dealer for assistance in calculating this information. The length of time that the sprinklers are on each string will be used to determine the amount of water used; overestimation of the time is better than underestimation. The month's sprinklers are used will be used in the calculation of total water needed for sprinklers. Again, overestimation of use is better than underestimation. There is a text box for use in explaining the procedures in the wash pen. When in doubt, add comments to be sure the entries are explained.



Once the information on the wash pen is entered, the user will be given the opportunity to

396

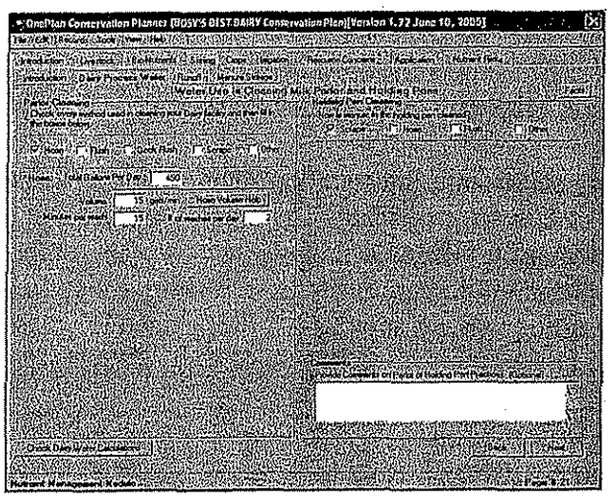
enter information about cow prep in the barn. Normally, about .5 gallons per cow is used to wash cows in the barn when drop hoses are being used. Users can include water from a backflush system by checking the "Yes" radio button. Automatic systems use about .5 gallons per cow. When manually backflushing, .5 gallons per cow is a reasonable number to use for water usage.

Note: The "Check Dairy Water Calculations" button is again available to provide a summary page that now includes the additional water that has been added as a result of the input from this screen. It is quite handy to review all of the water that has been included up to this point.

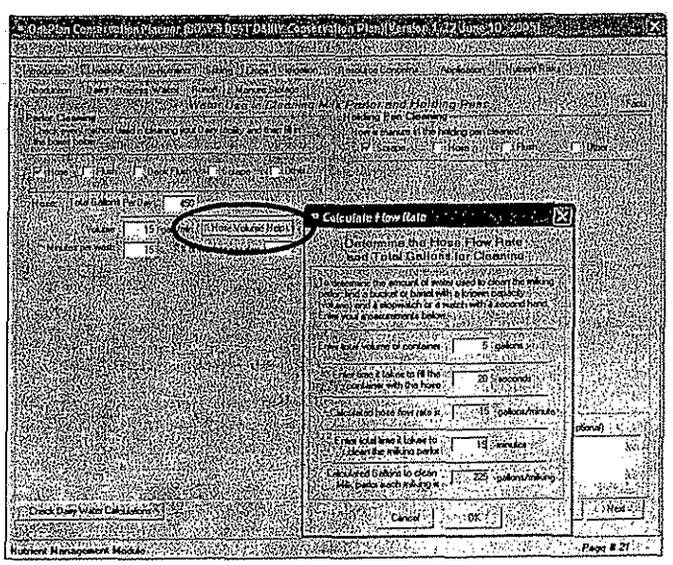
Water Used in Cleaning Milk Parlor and Holding Pens

The next step is to enter the water used in cleaning the barn and holding pen. The various methods of barn cleaning and holding pen cleaning are listed in "Check Boxes" on the Water Use "Tab".

Check the cleaning method or methods being used in the barn or holding pen or the method that best describes how your barn or holding pen is cleaned. The method(s) selected will become active and will allow you to enter data.



Hose Volume Help



Note: The hose method has a "Hose Volume Help" to assist the user in determining the flow rate by timing a collection in a bucket. When the user enters the volume of the container and the time it takes to fill the container; the program displays the calculated flow rate. Entering the time to clean the parlor results in the display of the calculation for gallons per milking.

397

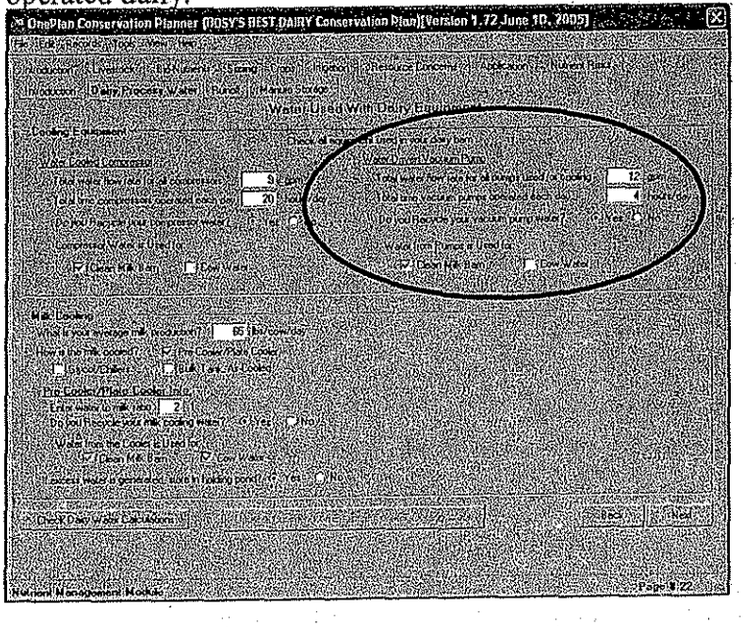
When using the flush method of barn cleaning, the user will need to know the flow rate of the flush. If this information is not available, consult the dairy equipment dealer.

The deck flush method will require the entry of the number of nozzles being used to do the deck flushes. The flow rate and minutes per flush must be entered, along with the number of flushes per day. Again, overestimating the amount of water used is better than underestimating water use.

Water Used with Diary Equipment

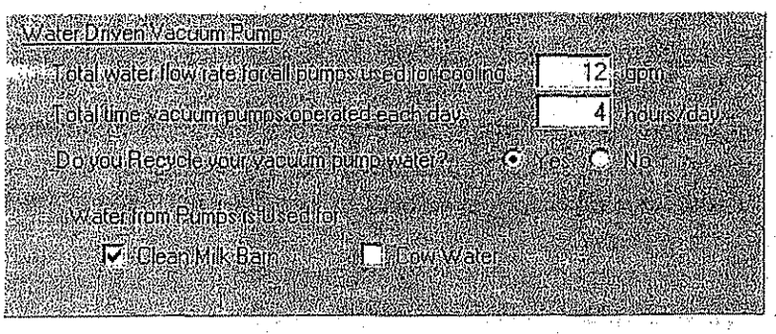
In some cases, cooling equipment water can make up a sizeable amount of the total water to be stored. The planner must visit with the producer and determine all sources of water that comes from the cooling equipment. Cooling water may be used for vacuum pumps, compressors for cooling equipment on bulk tanks and for cooling the milk equipment itself. The use of water to cool can increase efficiency and reduce energy requirements for the dairy operation, but in many cases, poor planning for disposal of cooling water has created an extra problem in the management of waste. Cooling water should be recycled where possible to take advantage of the increased temperature of the water once it has been used for cooling. Use of this water for washing cows and for cow drinking water can be highly beneficial from an energy conservation standpoint.

Compressors are often cooled with water. If a water-cooled compressor is used in the barn, check the "Check Box" and the cells become active and ready to accept data. Enter the flow rate in gallons per minute for the compressor. If unknown, try to contact equipment dealers to help identify the water use. Enter the total time the compressor is operated daily.



Note: This entry requires that the information be entered in minutes per day. If water is recycled, it is not added to the lagoon unless the amount of water needed in the areas that utilize recycled water is less than the amount of water generated through cooling of the compressor.

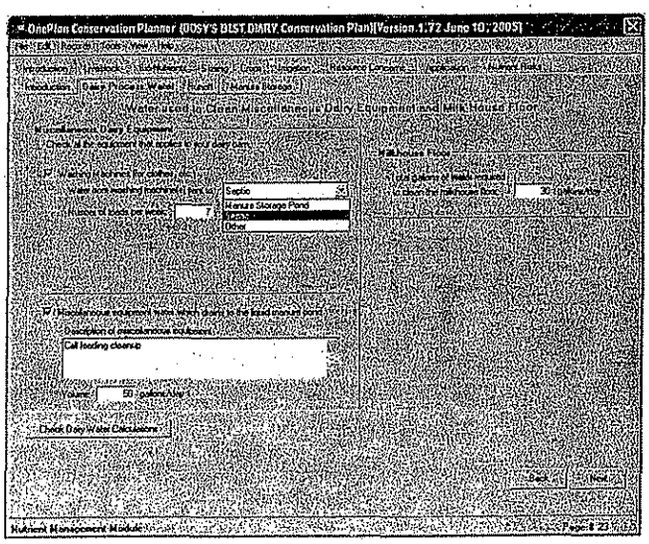
When the radio button Indicating that cooling water is being recycled is selected, the planner will be required to identify where water is being recycled. Check the appropriate "Check Box (es)" to indicate where the recycled water is being used.



Vacuum pumps may also be water-cooled. Just like compressors, the user must provide the gpm usage of clean water and the minutes per day that the cooling is needed. Again, identify if the water is recycled and where the recycled water is used. If the water used for recycling is less than the amount of water needed, the excess water will be sent to the lagoon, unless otherwise specified.

Milk cooling is another source of water used for cooling. Plate coolers generally use up to 2 gallons of water to cool 1 gallon of milk. The program will allow the user to adjust the ratio values as needed. Entering the production allows the program to calculate water usage for cooling. Check the boxes for each system if multiple systems are being used. For example, a producer may use a glycol chiller and a plate cooler.

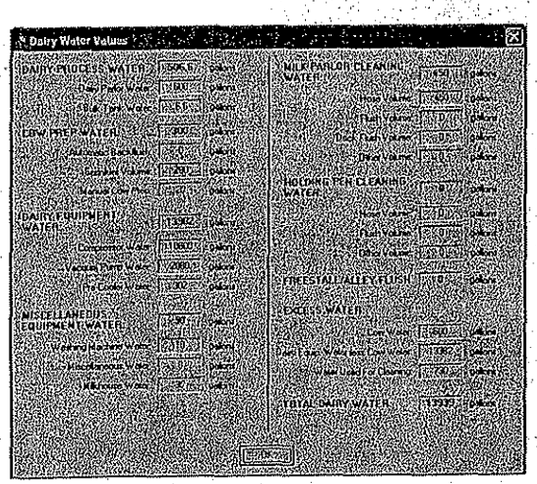
Water Used in Cleaning Miscellaneous Equipment/Milk House Floor



The final entry will gather miscellaneous uses of water. These uses are generally not considered recyclable. The washing machine water drop down allows the user to identify the disposition of the water; it may go to the lagoon, septic tank or be handled separately.

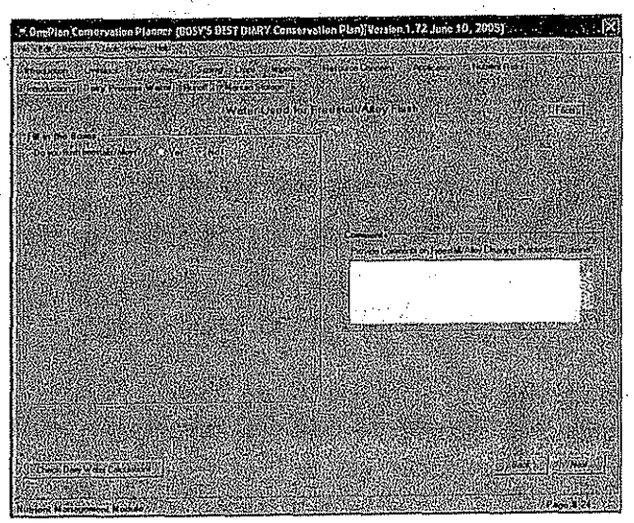
399

Dairy Water Calculations Page



Note: The "Dairy Water Calculation Sheet" gives a view of all of the water uses that have been entered. You cannot edit in this screen, so you will need to go to the tree (CTRL T) to move to the correct spot to make the edit or correction.

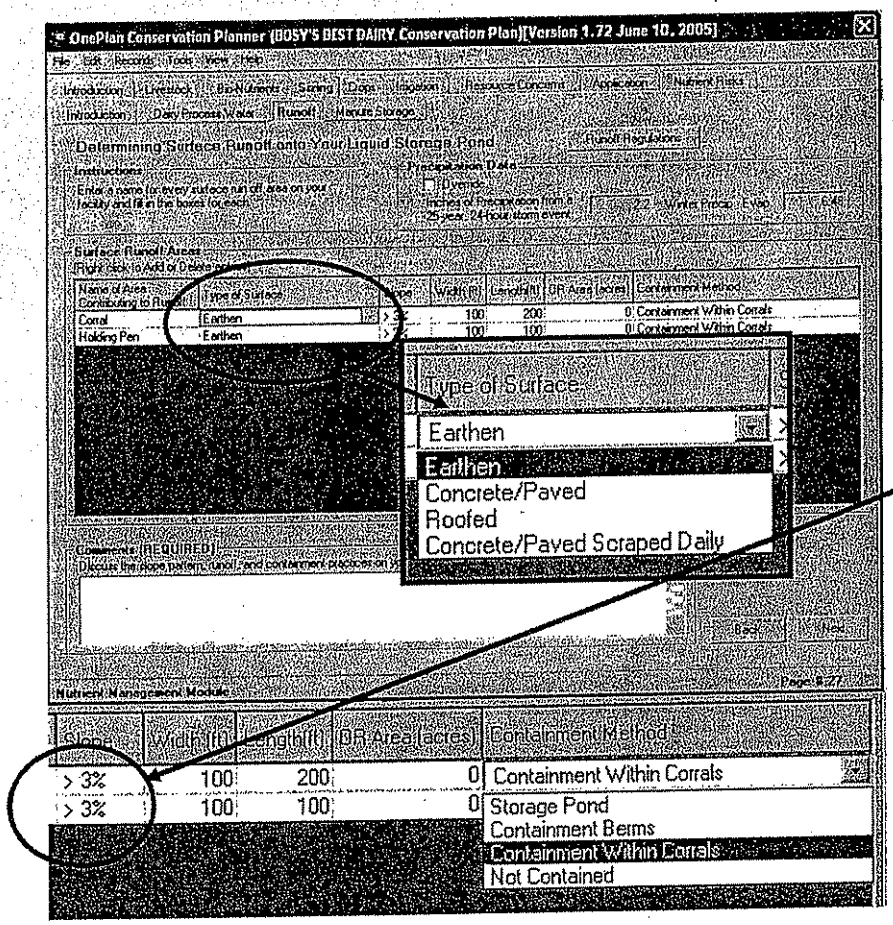
Flush of Freestalls and Feed Alleys



The flush for freestalls and alleys will affect the amount of water to be stored if flushing is done with non-recycled water. When non-recycled water is used, the amount of storage required increases by a large amount. When recycled water is used, the volume changes only by the amount of manure that enters the storage since the water has been used previously. Be sure to accurately reflect the amount of manure being stored in the Bionutrient group.

400

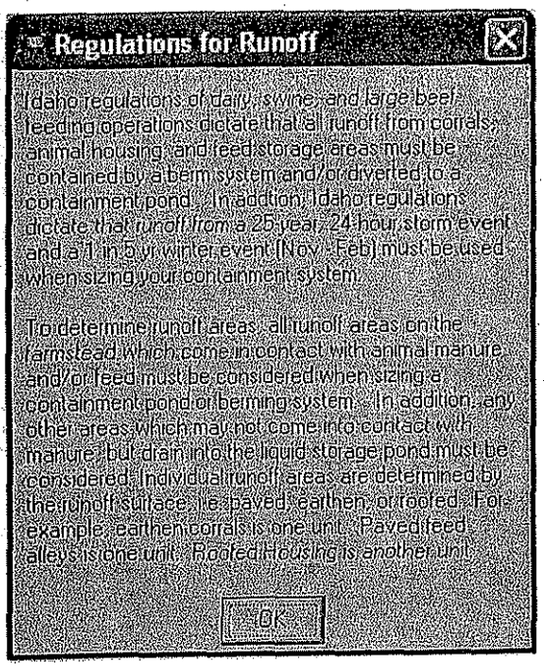
Runoff Calculations



The Runoff Section must be completed to have a certified plan. Field runoff containment, if there is a potential for runoff, should also be described in this section. There are that provide the type of surface from which the runoff originates, the slope of the area contributing to runoff and the method being used to contain runoff. The rainfall data, which is populated in the cells at the top of the page, is based on the weather station selected earlier in the program. These values can be increased but must not be decreased. The calculation for runoff is made for each runoff area. Individual areas are entered on the top line (Surface Runoff Areas). **Note:** The type of surface that is used and the percent of slope will dictate the runoff factor being used.

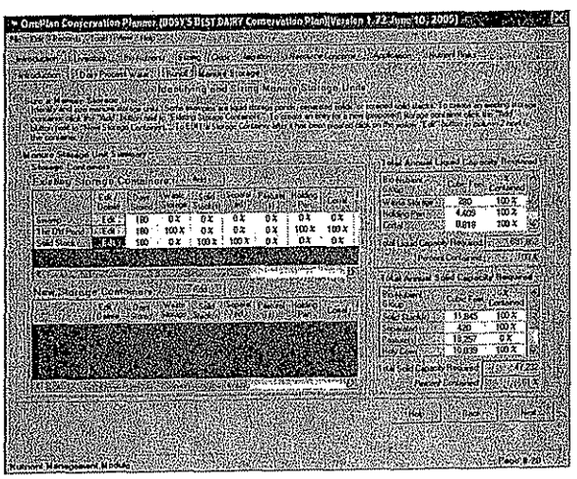
When all information is entered for an area, press "Next Runoff Area" to proceed to a blank line to enter a new area, or "Finished" to save the current entry and allow the program to proceed to the next entry "Tab".

Note: If an area is incorrectly entered, the user must select the faulty entry and delete it. Once the bad data is deleted, the area may be re-entered.



The Runoff Regulations button on the upper part of the screen will provide the planner with a brief overview of the regulations that apply for runoff on livestock operations in the state of Idaho. This information has been provided for the convenience of the user; however, for up-to-date information, check
with the Idaho State Department of Agriculture.

Identifying and Sizing Storage Units



When the sizing option was selected earlier in the program, the software will require the user to identify storage units to store all of the liquid waste from process water, runoff and manure being stored. The planner can identify the existing storages and, if necessary, add additional storages to contain all of the liquids that must be contained. The "Annual
Liquid Capacity Required" table on the right hand side of the entry screens provide the planner a quick check to insure that all liquid manure and runoff that was identified as requiring storage has been accounted for in the module. In addition to liquids the "Annual Solids Capacity Required Portion" table will provide the same check for solid manure insuring that adequate storage is provided for the manure which requires storage.

The program has a feature that allows the planner to calculate the amount of storage provided by existing storage and to add additional storage if needed to meet the necessary storage requirements.

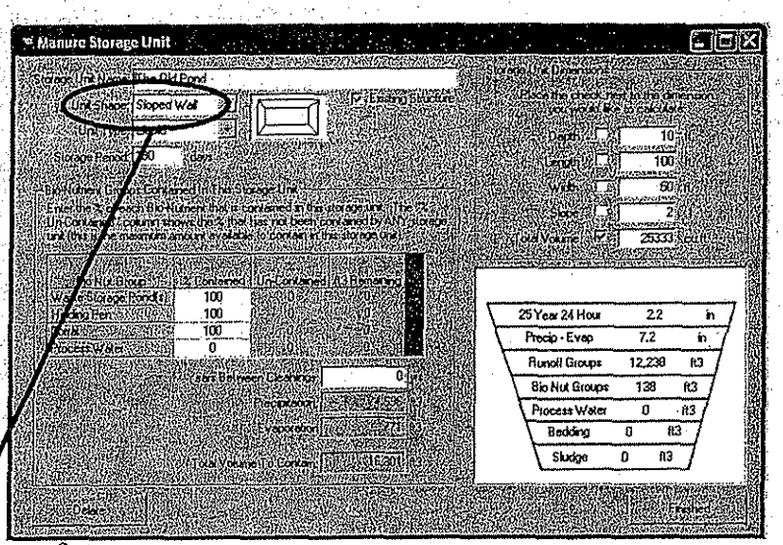
The sizing tool is used by first determining the % of a particular source of waste that must be stored in a particular storage unit. In the example below, one half of the source

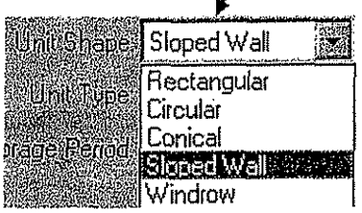
402

is being stored in this sloped wall liquid storage unit for a total period of 180 days.

Storage Sizing Tool – Side Slope Storage

When entering the Information for the structure, the planner may either enters the dimensions and solve for the amount of volume, or enter the volume and solve for any one of the dimensions by checking the box of the dimension for which they wish to solve. This is particularly useful when calculating either new facilities or for additional storage units on an existing facility when there is a shortage of storage.



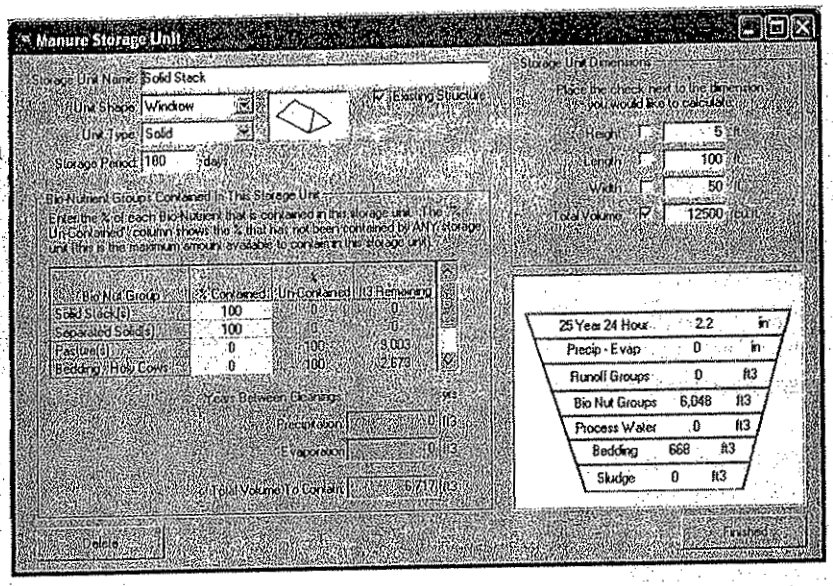


Several different types of storages or several of the same type of storages can be used to contain the necessary waste. The different types of storages that can be calculated with the storage calculation tools are listed to the left.

When the planner selects the "Add" button in either the "Existing Storage Container" or the "New Storage Container" he/she will be given a screen in which he/she can name and determine the quantity that can be stored in a given structure. The planner will define the actual containers for the storage and will need to continue to add and size storages until all of the waste is contained. The program will calculate the remaining amount of storage needed, updating the values after each storage is added until all of the storages have been created and sized. The tables on the preceding page will be updated with each storage that is added.

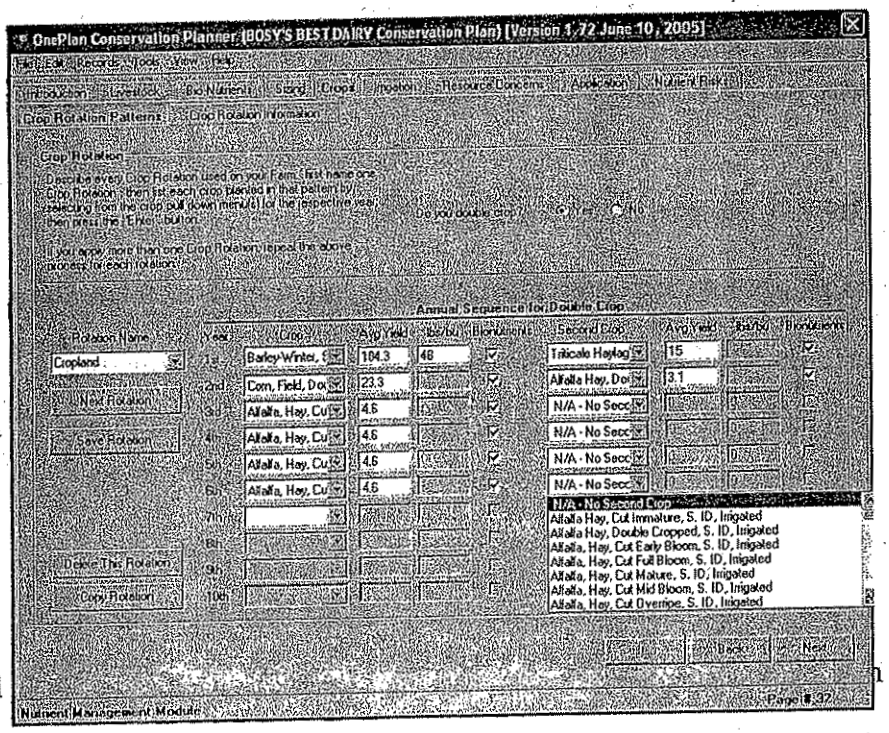
403

Just as in the liquid storage structure design feature of the program, the planner has the option of selecting a solid storage structure design. When developing a plan, a planner should refer back to the Sizing Manure Storage Screen to see that all of the required storage is accounted for before moving on to the next section of the plan.



Crop Rotations Patterns

In preparation to calculate the amount of nutrients that are being used by crops and how much manure that we will be able to apply, cropping information must be entered. The first step is to develop the various crop rotations that the producer is using in the farming operation. An infinite number of rotation patterns can be developed. The program is designed to allow the planner to use either single or double cropping patterns.

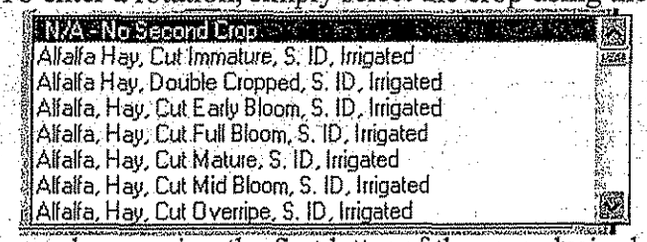


Double Cropping

The double cropping system has been revised to allow the planner to use pre-exist soil test data for Phosphorus and Potassium (test data within the last 9 months). The module utilizes nutrient uptake rate for each crop selected developed and are listed in the crop selection drop down box. Crop uptake for the various crops is based on the crop yield. It is important that the planner uses the same unit of yield as the data entered in the programs data base. Units of Yield can be in tons, cwt, lbs or bu/acre, In the case of small

grains, it is also based on the test weight for the grain produced, and the exception is barley production in Northern Idaho where it is listed in lbs/acre.
Note: Make sure that you do not duplicate the name of any of the rotations. If two rotations using the same Rotation Name are entered, the program will fail.

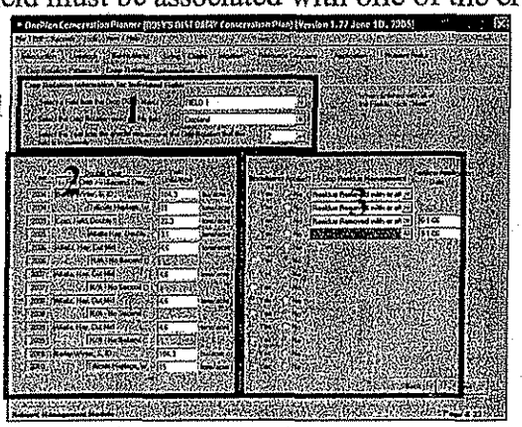
To enter a rotation, simply select the crop using the drop down box (shown at left) for each year in the rotation. **Note:** If there are more years in your rotation than the ten allowed, enter the first ten in the rotation beginning with the previous year crop. **In addition:** The user can easily scroll through the crops by pressing the first letter of the crop desired. If the double crop "Radio Button" was checked, a second set of columns in which to enter the second crop grown for the year will appear. **Note:** The rotational crops information required includes whether bio-nutrients will be used on a given crop. If the check box for bio-nutrients is not checked when the program calls for bio-nutrient application later in the program, the crop will not be available. In years when a second crop is not grown, enter "N/A - No Second Crop" as the second crop.



When finished entering a rotation, press the "Save this Rotation" button to insure the rotation is saved. If you have additional rotations to enter you may just press the "Next Rotation" button and the current rotation will be saved and a new blank screen will be displayed for an addition rotation. If a new rotation that is nearly identical to one that already has been entered is needed, press the copy rotation button, make the necessary changes, including providing a new name and the rotation will be created. When all rotation patterns have been entered, press the "Next" button to proceed to the next section.

Assigning Crop Rotation Patterns

Once the rotations have been completed, each field must be associated with one of the crop rotation patterns that have been entered. **In SECTION 1** the planner will need to assign the desired rotation schedule, and when the assignment is made, the user will be asked to identify which of the years in the rotation selected is the current year for the field. **In SECTION 2,** the planner will be given an opportunity to adjust the yield information for the specific field being entered. The use of bio-nutrients can also be changed for a specific field at this point, as well.



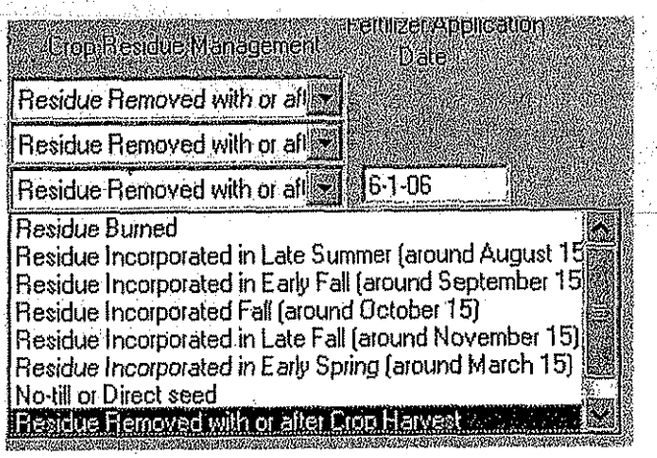
SECTION 3 asks for the fertilizer application date. **The fertilizer application date is the date by which the producer would normally have applied nitrogen fertilizer.** The program uses the date to evaluate if the soil test data can be used so that fertilizer application recommendations can be made. If the soil test is out of date, (within 90 days of the fertilizer application) no

405

nitrogen recommendations can be made. **Note that Phosphorus and Potassium application dates has to be within 9 months of the application date.**

Crop Residue Management

Section 3 also requests specific information on the practices used for residue management. The information requested is input by selecting the appropriate item from the drop down box.



Irrigation Planning

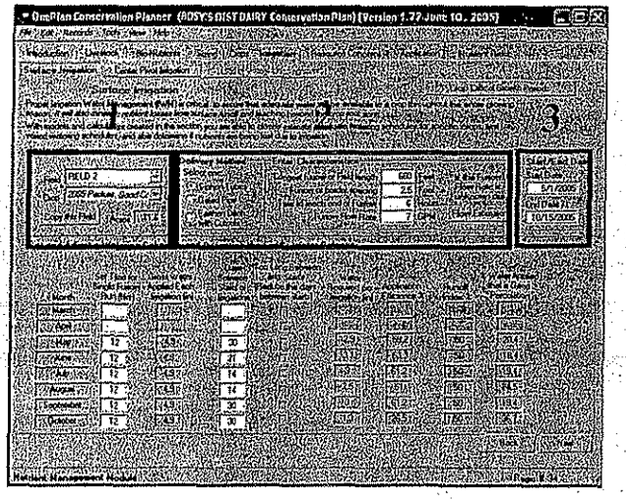
Irrigation plays a major role in the movement of nutrients, both off the field when runoff occurs and in field when nutrients can move through the soil profile under deep leaching conditions. Proper irrigation will result in making the best use of nutrients for crop production and will reduce the potential for environmental degradation due to the movement of nutrients from a beneficial site (crop root zone) to a non-beneficial site (surface and ground water). This section is required for a certified plan. If the user follows the irrigation plan he/she will maximize the use of water and nutrients for crop production and at the same time will minimize the impact of those nutrients on the environment.

Once the field, its crop rotation, and year in the crop rotation have been determined, each field will be associated with the irrigation system that was established in the "land use" selection on the "Map Your Farm" window. The three irrigation tabs (Surface Irrigation, Center Pivot Irrigation, or Hand or Wheel Line Irrigation) are automatically activated as the planner proceeds through the irrigation model. Each irrigation model is unique in its ability to evaluate the system. However, all three systems are similar in type of information required. The instruction section for each system contains three sections:

1) **Field Selection,**
2) **Irrigation System Characteristics, and**
3) **Irrigation Start/End Date.**

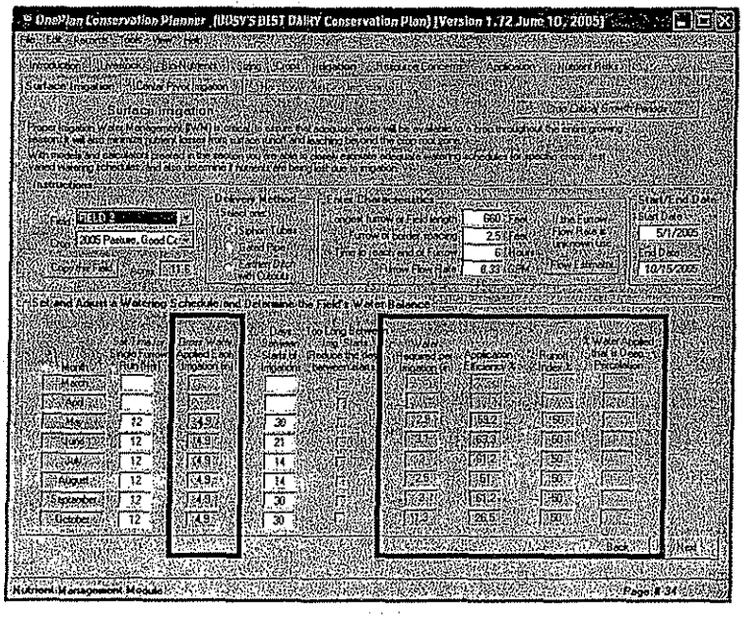
406

The first step in the surface irrigation process, **Field Selection section**, is for the planner to identify the field.
In Irrigation System Characteristics section, the planner will be given an opportunity to characteristics of the Irrigation System and the Field.
Irrigation Start/End Date section asks the planner for seasonal irrigation start and end dates. These dates are used by the model to evaluate irrigation efficiencies based in Net Irrigation Requirement (NIR) and determines the date of water balance accounting to evaluate whether the system is under deficit or leaching moisture conditions.



Surface Irrigation

Surface irrigation is the least efficient of all irrigation systems. This section serves as a tool to evaluate the efficiency and the potential damage that can result from using a surface irrigation system.



The system has been revised allowing auto calculation and immediate viewing of "Gross Water Applied Each Irrigation, Water Required per Irrigation, Application Efficiency, Runoff Index Percent and Percent Water Applied that is Deep Percolation".

To use the surface irrigation tool, the user must first define the type of delivery method the surface irrigation system is using.

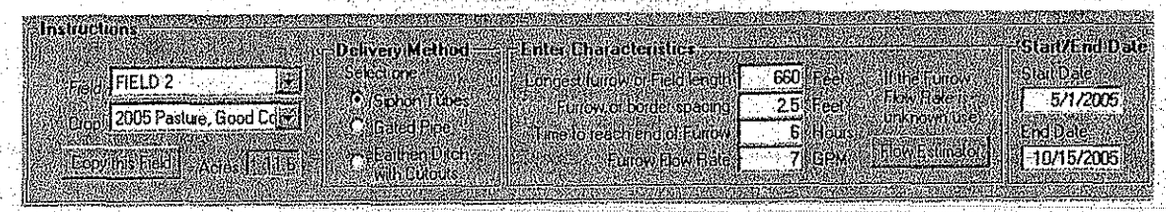
The three types of Delivery methods that a producer may be using are:

1) siphon tubes,
2) gated pipe, and
3) earthen ditch with cutouts.

407

Siphon tube and Gated pipe allow the producer to control the water better than the earthen ditch.

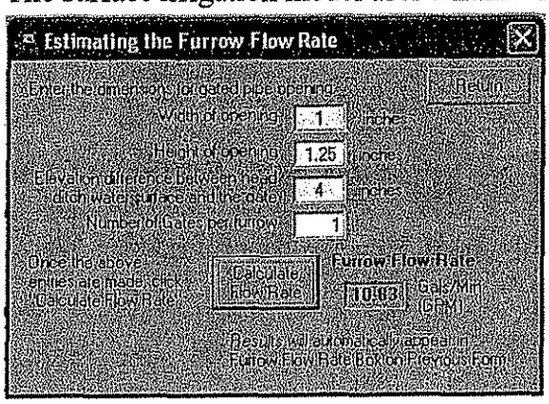
The next step to take in evaluating a surface irrigation system is to "Enter Characteristics" of the field. These values of furrow or field length furrow or border



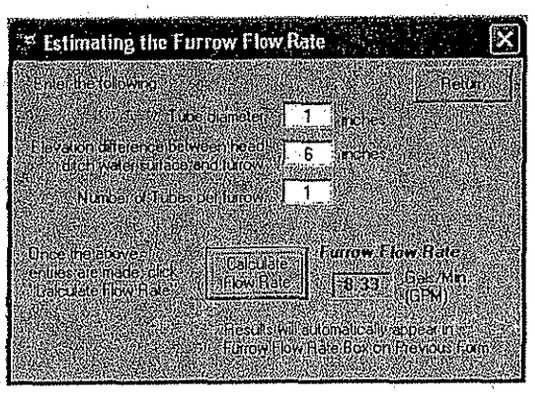
spacing and time to reach end of furrow, and furrow flow rate are used by the model to calculate gross water applied, irrigation required, %runoff, application efficiencies %, and the % potential for deep leaching.

Flow Rate Estimator

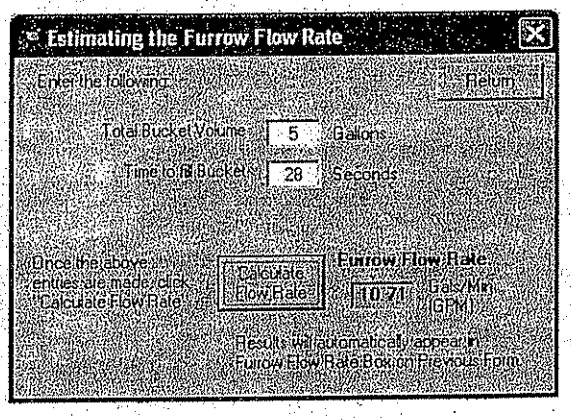
The surface irrigation model uses a number of parameters that influence the flow rate in a furrow. The model uses a flow estimator, can be invoked by pressing the "Flow Estimator" button, to assist the planner in determining the furrow flow rate for the Delivery Method. For example, if the grower is irrigating with siphon tubes. This tool requires the user to enter the diameter of the tube, the elevation difference between the water level in the ditch, and the level where it is discharged from the tube into the furrow. The greater the difference in elevation and the larger the tube, increases the resulting flow rate.



To estimate flows for Gated Pipe systems the planner would select the "Flow Estimator" for a Gated Pipe system, selects the width and height of the gate opening on gated pipe, select the elevation difference between the gate and the level of water in the ditch. The flow will be provided by the "Flow Estimator". This flow value is then entered in the appropriate line on the data entry form.



408

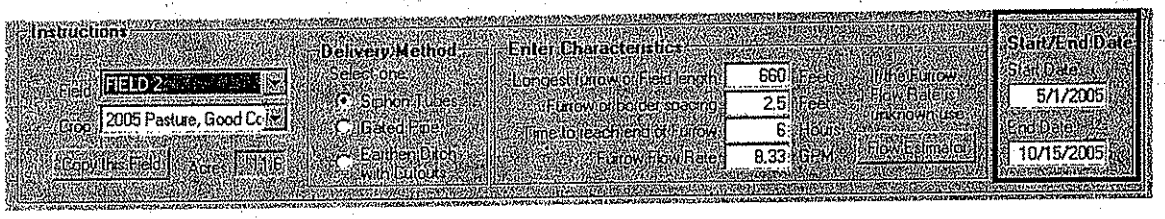


The program also provides a "Flow Estimator" for earthen cutouts. This tool requires the user to collect a volume of water in a bucket and to record the time to collect the volume. The bucket collection method may be somewhat difficult to complete. Another method to consider would be to identify the flow delivered by the irrigation district or company, i.e., 1 cfs = 454 gallons per minute. If 1 cfs is distributed to 100 furrows, the flow rate would be 4.54 cfs.

Irrigation Start/End Dates

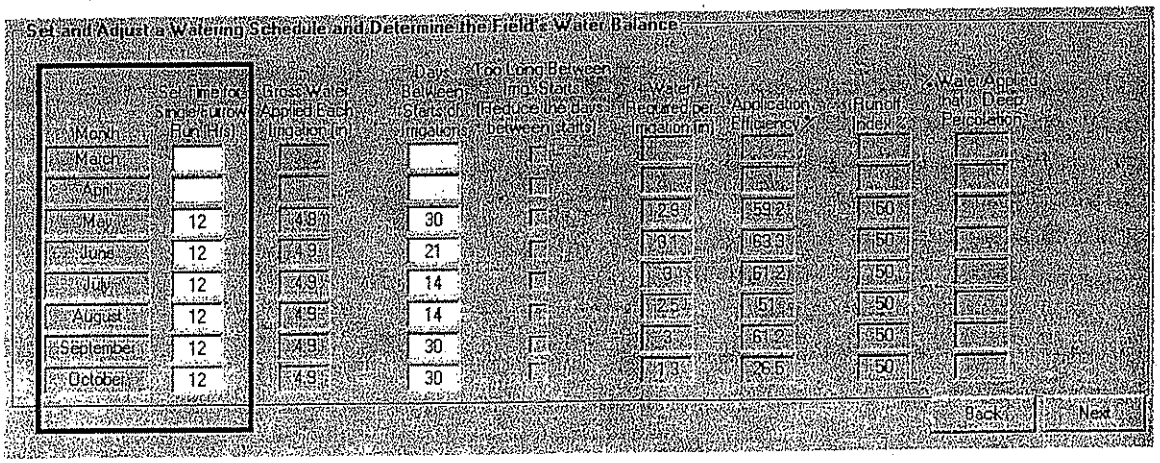
The **third** step to take in evaluating a surface irrigation system is to enter the seasonal Start/End dates.

3



The dates start the NIR calculations for the current crops in the rotation and are utilized to determine if the system is over or under irrigating.

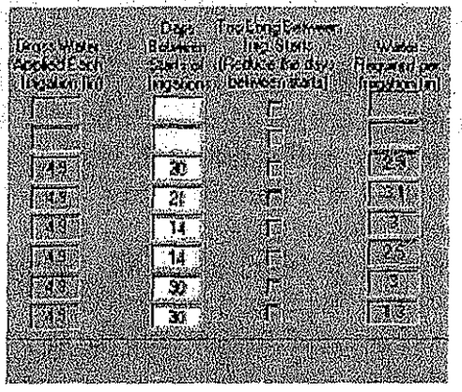
The next major step in evaluating a surface irrigation system is to enter the "Set Times for Single Furrow Run".



Enter the set times for each month when the selected field will typically be watered. In the example above, set times are for 12 hours and the months of irrigation are from May 1 until October. Once the set times are entered the program will automatically calculate "Gross Water Applied Each Irrigation (in).

Irrigation Efficiency

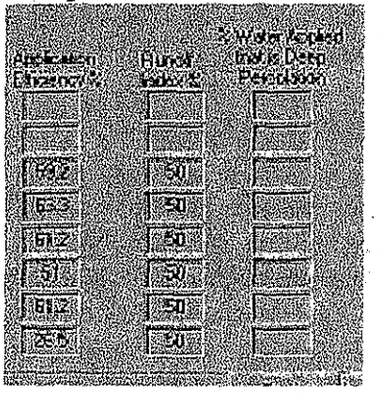
The planner will then proceed to enter the "Days Between Start of Irrigations". Since the surface irrigation module works on monthly Net Irrigation Requirement (NIR) averaged over the month, the model assumes start of irrigation at the beginning of each month and will carryover NIR data from the last day of the preceding month. When the planner



provides the approximate number of days between Irrigations and evaluates the irrigation system's ability to provide the needed water for crop production based on the length of set time and the flow rate. The water holding capacity is based on information found in the soils layer of the GIS data. **Note:** After the each "Days Between Start of Irrigations" information is entered the "Too Long Between Irrig. Starts" months with check marks in the check boxes indicate a lack of water to meet crop needs. Also when the planner enters each "Days Between Start of Irrigations", the program will calculate the NIR, "Water Required per Irrigation" and evaluate the system's ability to deliver the necessary water to meet crop production needs without applying excess water that will move nutrients through the profile. The planner can make adjustments in the length of sets, flow rate and/or the interval to allow the system to meet the crop needs while maximizing the "Application Efficiency %" and reducing the movement of water through the crop root zone into the ground water.

Determining Excessive Runoff

The Surface "Runoff Index %" is calculated as an indicator of the potential for loss of soil and nutrients due to surface runoff. A runoff index of at least 25% is necessary to allow for uniform wetting of the soil by providing enough time for water infiltration at the end of the field. Runoff indexes of shorter durations indicate a higher potential for erosion and nutrient losses. To increase the index, increase the set time and/or increase flow to reduce time to end of the furrow. To reduce the index, reduce the set time or reduce the flow in the furrows.



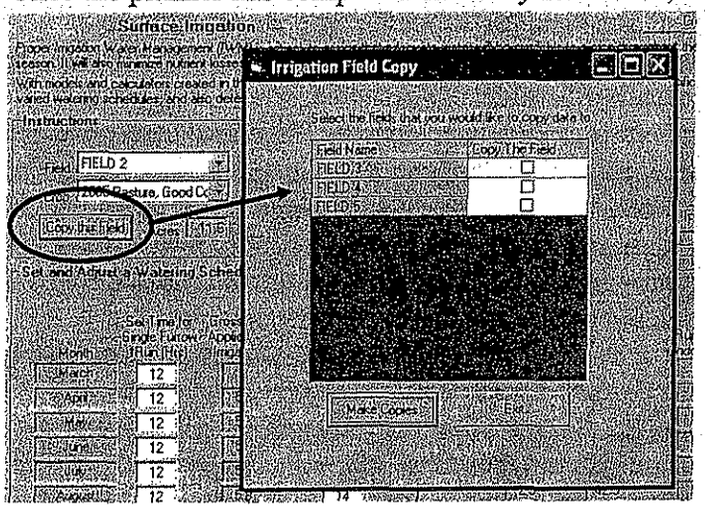
Estimating Effects of Deep Percolation

Deep percolation of irrigation water may carry nutrients through the soil profile and potentially could reach groundwater. The "% Water Applied that is Deep Percolation" calculation will evaluate the potential for moving water through the soil profile. The evaluation examines the amount of water used by the crop compared to the amount of water applied through irrigation. The difference between the amount of water used by the plant, evaporation from soil and plant plus that lost through runoff, and the total amount of water which was applied is considered to be

deep percolation which is water moving to the aquifer. This process has the potential to carry nutrients through the soil profile to the ground water and can generally be considered a waste of water. It is important to remember that aquifer recharge is also an important result of deep percolation of irrigation water. In many places in the state, irrigation is responsible for a substantial change in the ground water depth.

Irrigation Field Copy

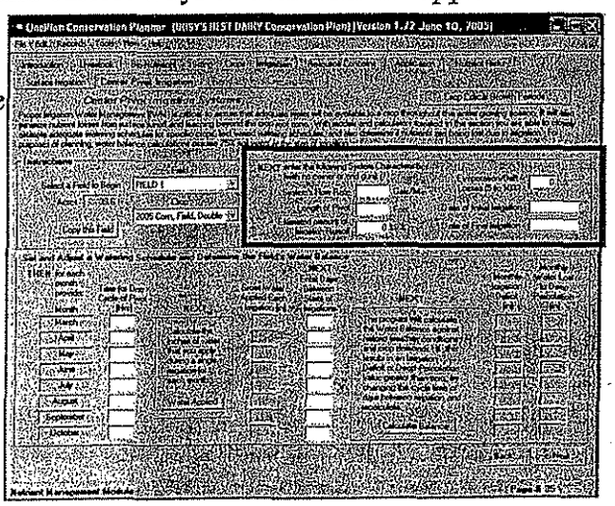
Once the planner has completed the entry for a field, the next field can be entered by returning to the top portion of the screen and selecting the name of a new field. The planner has a new option, "Copy this Field" for copying the finished field's irrigation information to the next field under the same system for irrigation.



When the irrigation information is entered for all fields under the Surface Irrigation, pressing the "Next" button will take the planner user out of this "Tab" and on to the "Center Pivot" or "Hand /Wheel Line" tab. If there are no fields identified as being irrigated with hand lines or with a center pivot, the program will move on to the next section in which the user will identify the fields with runoff.

Center Pivot Irrigation

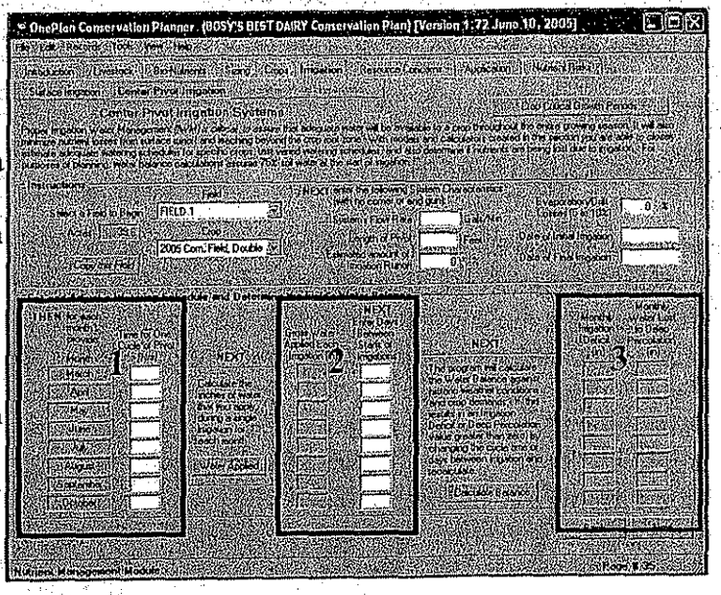
The center pivot system is one of the best and easiest ways to deal with the application of liquid manure. The flexibility in customizing application rates allows the producer to spread the liquid manure at the desired rate and uniformity across the field. As in the surface irrigation system, when the field is selected, the acreage and the crop for the current year information is populated. Enter the flow rate of the system in gallons per minute. If this information is not readily available, the irrigation equipment people who installed the system should be able to provide it. The next step will be for the planner to



411

estimate the amount of runoff associated with this method of irrigation. The amount of evaporation will also need to be estimated. The normal range for evaporation is from 10 to 15%. The higher pressure and smaller droplets will result in a greater amount of evaporation. The date of the expected first and last irrigations must be entered so the program can calculate water usage by the crop.

Once the system information has been entered, the next step is to enter the Irrigation Management information.



Section 1 in the lower part of The entry screen requires the planner to enter the number of hours that it will take to make a complete circle with the pivot. Typically, early and late season irrigation producers will speed up the travel of the pivot so that less water is applied. During the early and late season, crop evapotranspiration is lower than in the middle of the irrigation season. During the middle of the season, the system will need to apply more water to maintain crop ET needs. Care must be taken to avoid planning application rates that exceed soil infiltration rates. If application rate exceeds infiltration rate, runoff or ponding become a concern. Many systems are designed to meet less than the total crop ET needs during the high demand periods in July and August. Once the travel time for the pivot is entered in Section 1 of the screen, press the "Water Applied" button to calculate the amount of water applied per acre per revolution (irrigation) of the pivot.

The next step in evaluating the pivot irrigation system management is to provide the number of days between irrigations in **Section 2**. Early and late season irrigation will again require less frequent irrigation since crop ET levels are at their lowest point. Enter the estimated days between irrigations. Press the "Calculate Balance" button to calculate whether crop needs are being met or if excess water is being applied, resulting in deep percolation of water and nutrients. This information is displayed in **Section 3** of the screen.

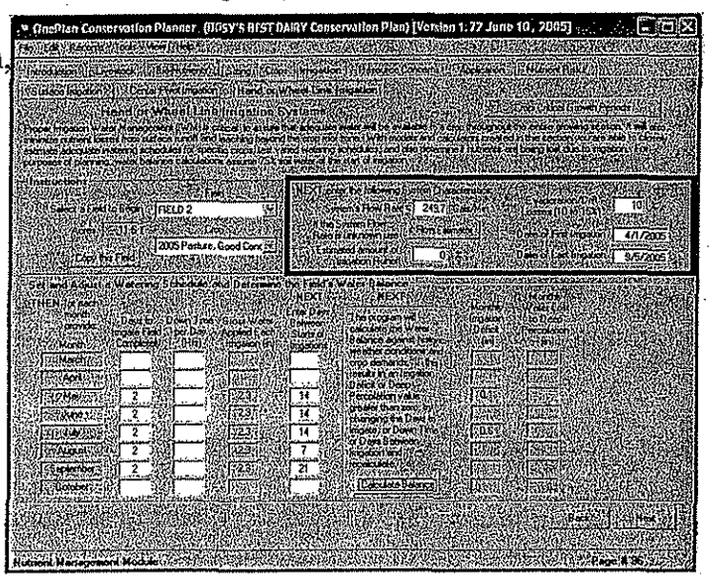
If soil moisture is at deficit levels, the planner should adjust the amount of water applied by either increasing the number of hours to make a revolution or by decreasing the interval in days between irrigations. Make the necessary adjustment and press the "Water Applied" button to recalculate the water application and then press the "Calculate Balance" button to recalculate the water balance information.
If deep percolation of moisture and nutrients is indicated, the planner should adjust the amount of water applied by either decreasing the number of hours to make a revolution or by increasing the interval in days between irrigations. Make the necessary adjustment, press the "Water Applied"

button to recalculate the water application and then press the "Calculate Balance" button to recalculate the water balance information.

Once the user has completed the entry for a field, select the next field to be entered in the drop down box on the top part of the screen. If there are additional fields having pivot irrigation systems, the program will provide a new input screen for the next field the planner chooses. Pressing the "Next" button will take the planner out of this "Tab" and on to the "Hand or Wheel Line" tab, if there are no fields with hand lines or wheel lines, the planner will exit the "Irrigation" tab and move on to the next section, in which the user will identify the fields with runoff.

Hand or Wheel Line Irrigation

The hand line or wheel line irrigation systems are also a good method to deal with the application of liquid manure. The flexibility in customizing application rates by varying application times allows the producer to spread the liquid manure at the desired rate and uniformity across the field. Just as in the previous two irrigation methods, when the field is selected, the acreage and the crop for the current year's information is populated.
To use the Hand or Wheel Line Systems section, begin by entering the flow rate of the system in gallons per minute. If the flow rate of the system is unknown, refer to the irrigation equipment manufacturer or the company that installed the equipment. If the user can not obtain the flow rate information, the "Flow Estimator" should be helpful in providing the information. An example of using the "Flow Estimator" can be found later in this section. The next step will be for the planner to estimate the amount of runoff associated with this method of irrigation. The amount of evaporation will also need to be estimated. The normal range for evaporation is from 10 to 15%. The higher pressure and smaller droplets will result in a greater amount of evaporation. The date of the expected first and last irrigations must be entered so the program can calculate water usage by the crop.

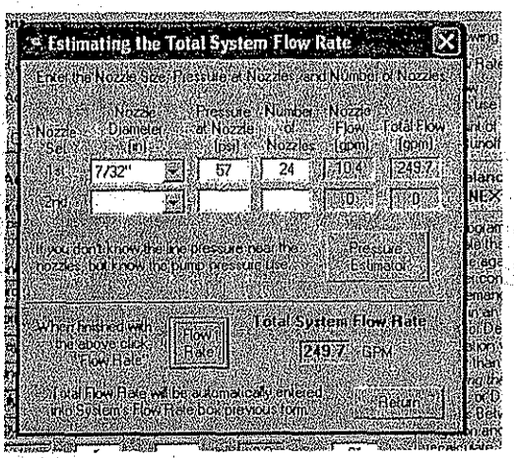


Flow Rate Estimator

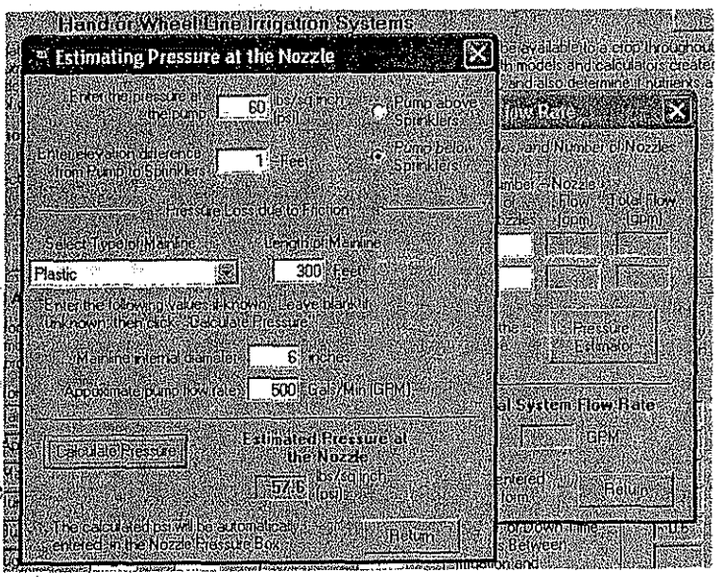
To use the "Flow Estimator" the planner will need to enter the nozzle size for the birds being used. If birds have a second nozzle, the second nozzle must also be entered. The pressure at the nozzle must be taken so that it may be used in the calculations for the amount of water output per bird. If the pressure at the nozzles is unknown, the program

413

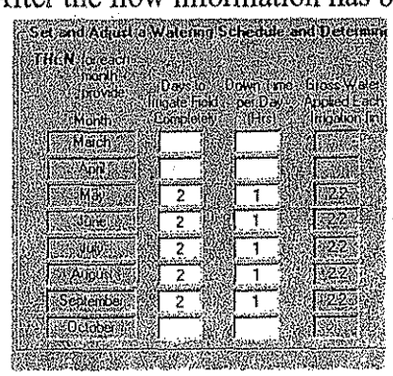
has a pressure estimator. The number of nozzles entered must be all nozzles used simultaneously on the selected field. For example, on our sample field; assume 2 hand lines are being used to irrigate the field. If each line has 18 nozzles, the number of nozzles would be 36 if the normal practice is to use both hand lines simultaneously.



When the pressure at the nozzles is unknown, the pressure can be estimated using the estimation tool. Enter the pressure at the pump and the difference in elevation between the pump and the sprinklers. The planner must identify if the pump is located above or below the sprinklers. The location will determine if there is a pressure loss or gain in the system. The type of mainline must be entered; different types of pipe have different coefficients of friction which affects the amount of? pressure loss. The size of the pipe and the flow rate also affect the amount of pressure loss within the mainline and must be entered. When all of the information has been provided, press "Calculate Pressure" and the estimated pressure will be displayed and returned to the pressure blank on the Flow Rate Calculator.



After the flow information has been entered the planner must provide irrigation information such as the number of days it takes to irrigate the field using the current irrigation system. Upon enter "Days to Irrigate Field Completely" and "Down Time per Day" the program calculates the "Gross Water Applied Each Irrigation". Depending on the operation, the producer may or may not be able to adjust the rate at which they are able to cover the entire field. Some canal systems are not designed so that producers can take periodic delivery of water; that is, they must take delivery 24 hours per day.



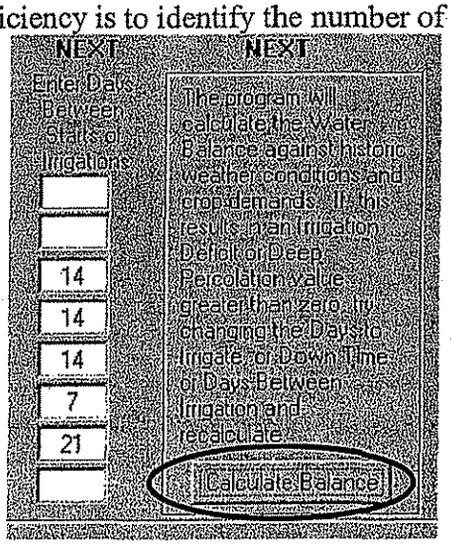
4/4

This practice can limit the flexibility in adjusting application rates to the crop ET needs. The time it takes to change the position of the lines on the field or the time the system is off for part of a day is called down time. The water that would have been applied during the time if the system were running will be subtracted from the total and can amount to a significant amount of water, particularly if the user is using a set time of 18 hours with the system being down for 6 hours.

During the early and late season, crop evapotranspiration is lower than in the middle of the irrigation season. Producers typically may adjust application from 12-hour sets to 24-hour sets. During the middle of the season, the system will need to apply more water to maintain crop ET needs, which usually results in the longer set times.

Care must be taken to avoid planning application rates that exceed soil infiltration rates. If application rate exceeds infiltration rate, runoff or ponding become a concern. Many systems may lack the ability to provide application timing or rates that meet the total crop ET needs during the high demand periods in July and August. Once the days to cover the field are entered, press the "Water Applied" button to calculate the amount of water applied per acre, per irrigation.

The next step in maximizing the irrigation system efficiency is to identify the number of days between irrigations. Early and late season Irrigation will again require less frequent irrigation since crop ET levels are at the lowest. Enter the estimated days between irrigations. Press the "**Calculate Balance**" button to calculate whether crop needs are being met or if excess water is being applied, resulting in deep percolation of water and nutrients. If soil moisture is at deficit levels, the planner should adjust the amount of water applied by either increasing application rate or by decreasing the interval in days between irrigations. When the planner makes application adjustment, press the "**Calculate Balance**" button to recalculate the water balance information.

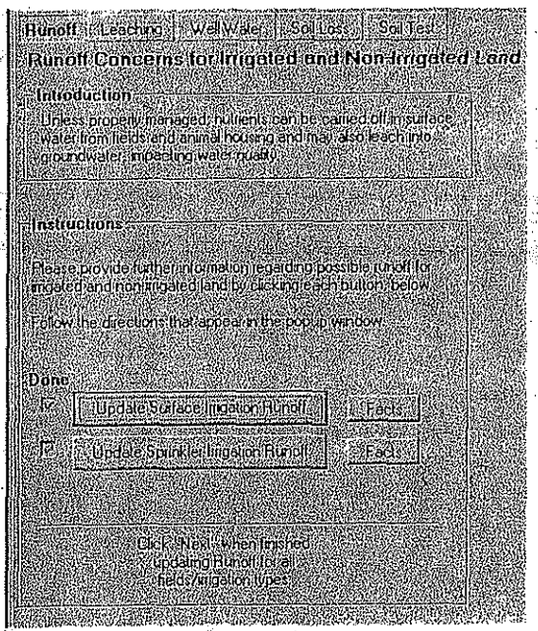


If deep percolation of moisture and nutrients is indicated, the planner should adjust the amount of water applied by either decreasing the application rate or by increasing the interval in days between irrigations. Make the necessary adjustment, press the "Water Applied" button to recalculate the water application, and then press the "Calculate Balance" button to recalculate the water balance information.

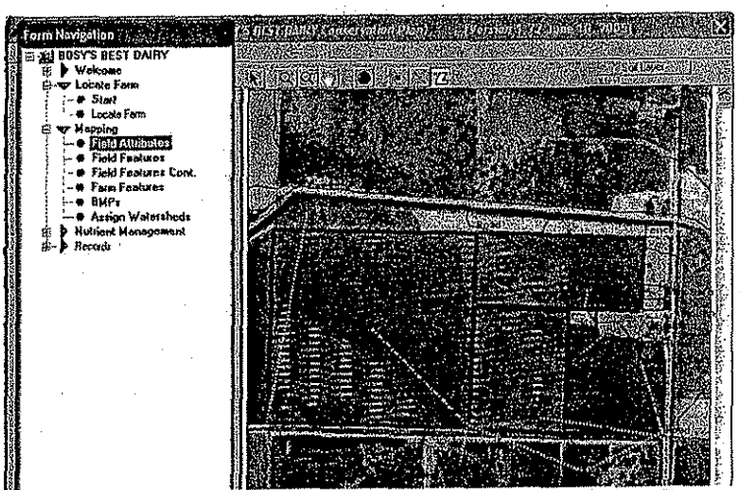
Once the user has completed the entry for a field, selecting a new field name will provide a new input screen for the next field the user chooses to select. Pressing the "Next" button will take the user out of this "Tab" and move on to the next section in which the user will identify the fields with runoff.

Resource Concerns

Field resource concerns must be identified to determine the proper method of plan development from a regulatory perspective. Those fields determined to have surface water as the primary resource concern will have different parameters than those classified as having ground water resource concerns. In this section the planner will identify if there are concerns from runoff due to surface irrigation or from sprinkler irrigation. The planner must identify runoff from both surface irrigation runoff or from sprinkler irrigation runoff. Checking the buttons as seen on the screen to the right will give the planner a map displaying the fields for the individual category selected (either surface or sprinkler).

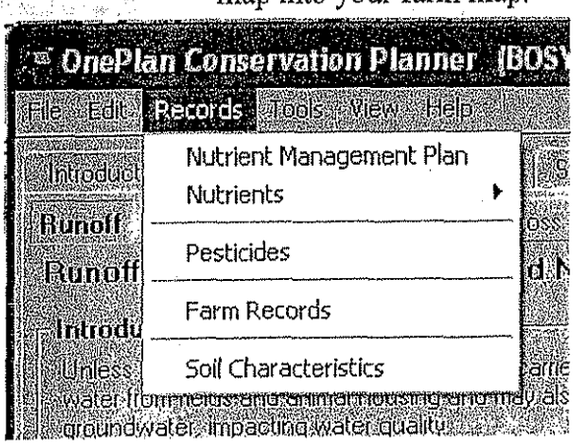


Records (Soil Characteristics)



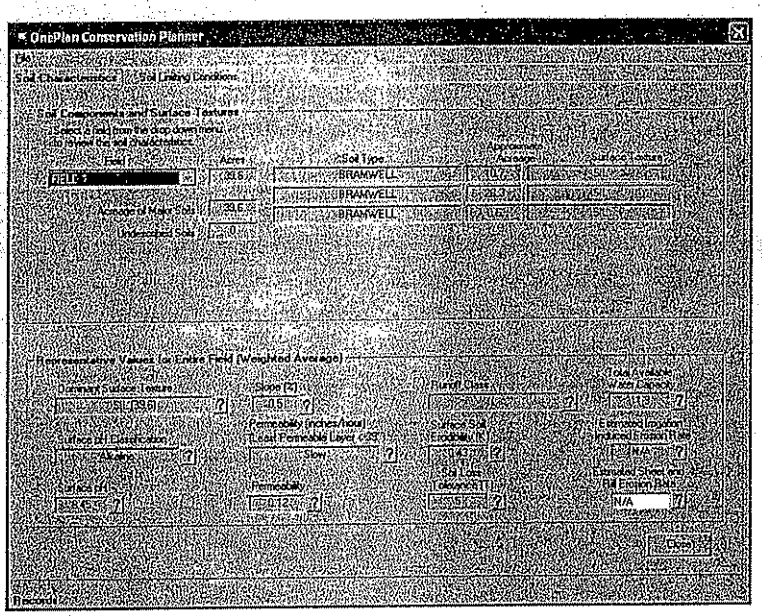
When the farm data is downloaded from the DWR server, the soils information downloaded is used by the various models within OnePlan. The planner can see the soils variability on the farm by accessing the "Forms Navigation (Ctrl+T)." By selecting "Field Attributes" under the "Mapping" the program will take you back to the "Map your Field" window. Clicking on the "Soil Layer" button will overlay the soil map into your farm map.

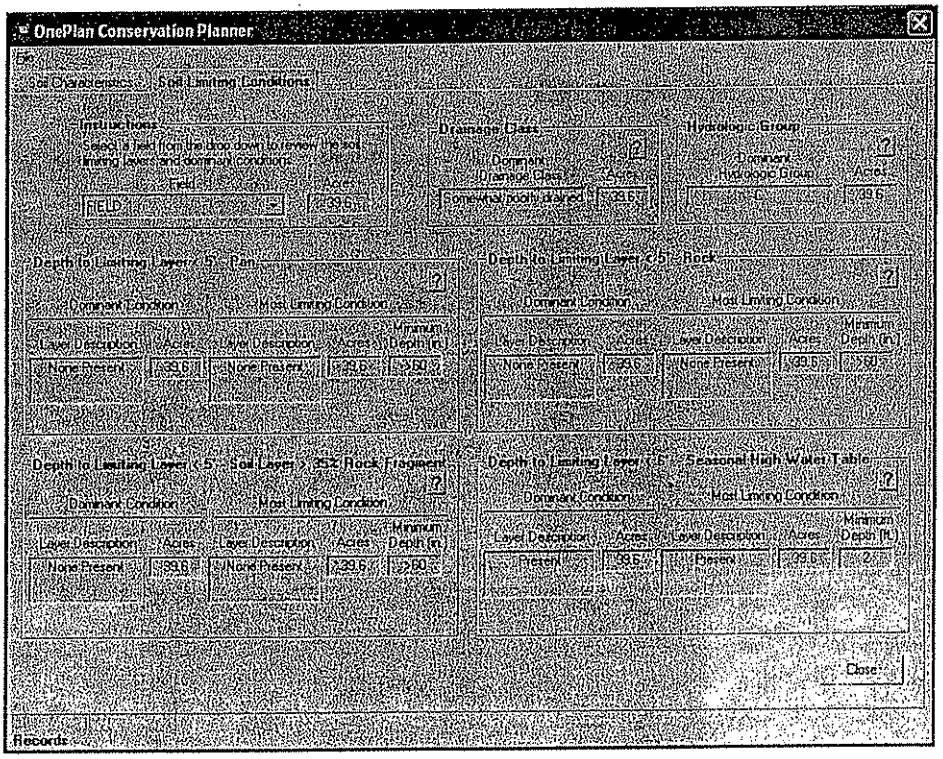
Table data can be opened by selecting the "Record" Tab the planner can access the data that are being stored and used by OnePlan in developing the calculated soil related data.



416

The "Soil Characteristics" file contains basic soil information.



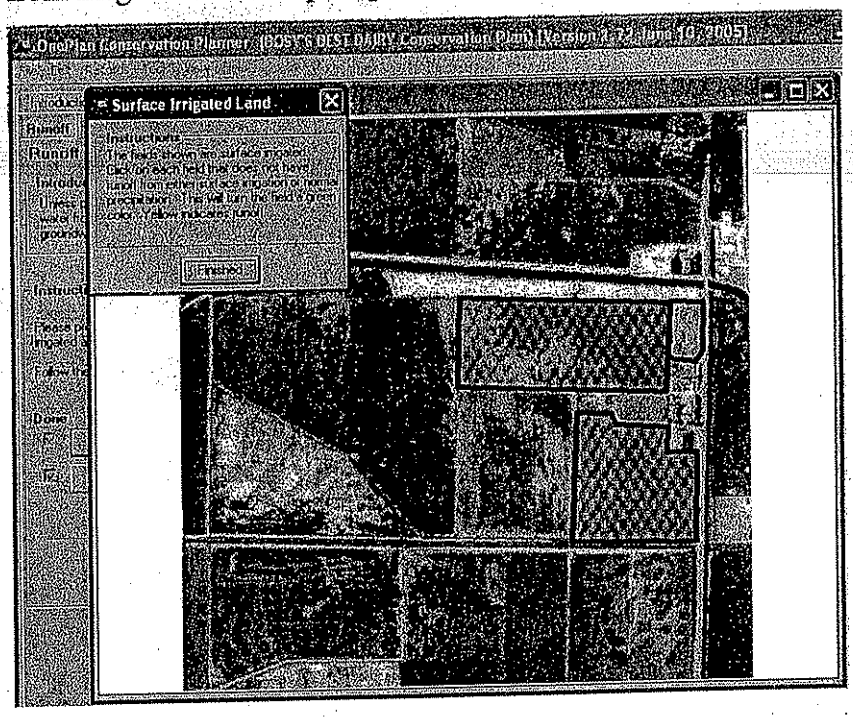


The "Soil Limiting Conditions" file contains data that the program utilizes in determining the presence of a subsurface feature that the program utilizes in determining groundwater risk assessment.

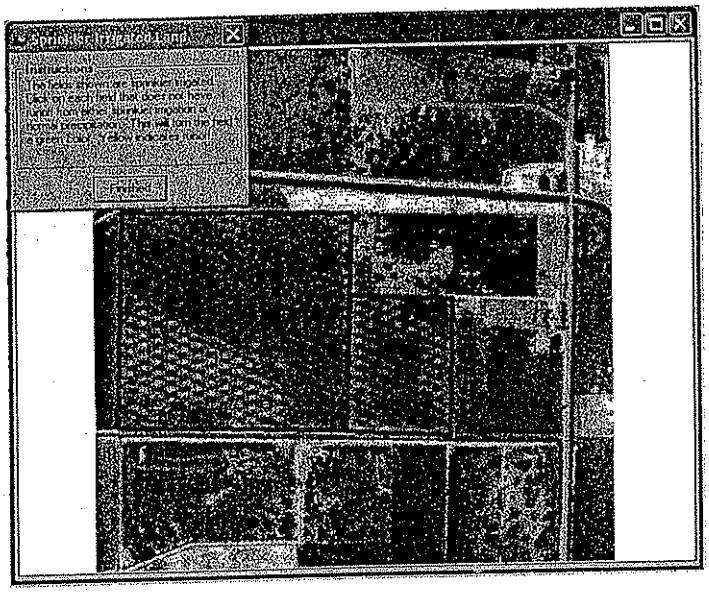
417

Field Runoff

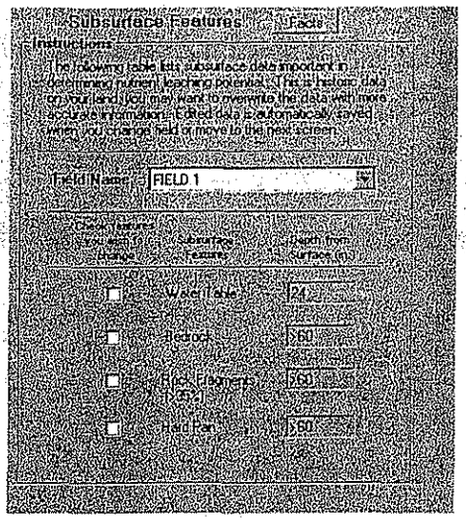
Fields receiving manure pose a special problem from runoff whether from irrigation or from precipitation. Either way, if runoff exists from the field, the Resource Concern becomes a "Surface Water" resource concern. Fields that are surface irrigated and do not utilize a pump back system are automatically assumed to have runoff. If a surface irrigated field does not have runoff the planner will identify that field by clicking within its boundaries which will turn the field green while the others remain yellow. See Example to left.



The sprinkler fields as seen in the screen to the right must be identified if they **DO NOT** have runoff by "Clicking" on the field. If a field is not identified by selecting it, the assumption will be made that there is runoff, and thus, the resource concern is for surface water.

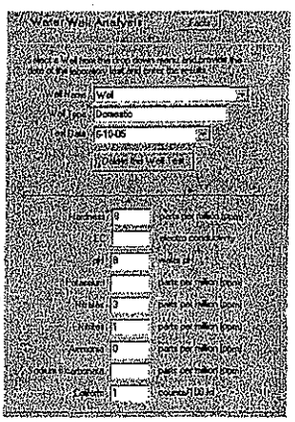


Subsurface Features



The GIS layers which are downloaded with the maps include a great deal of information about each of the fields. This information is part of the soil classification information. In some cases this information may not be accurate for a small site such as an individual field. The Subsurface Features screen allows planners to modify the information that was imported with the maps if it does not accurately describe the individual field. The planner will check the box or boxes of the information which needs to be changed? One the box has been checked the planner simply makes the necessary change and moves on to the next field or presses the "Next" button to continue on to the next section.

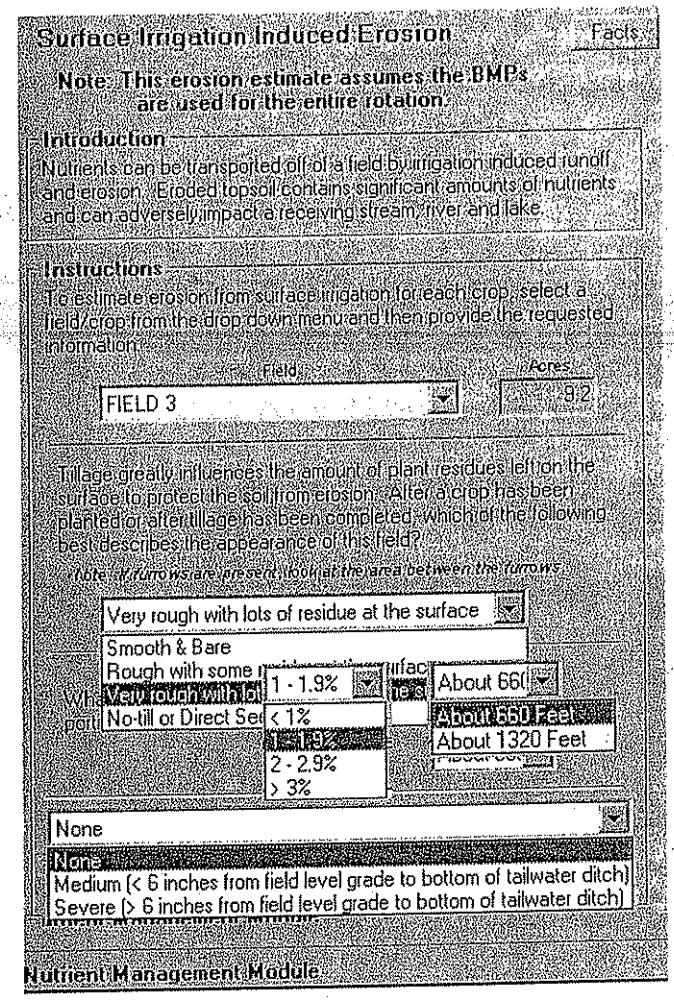
Well Water Analysis



The Idaho State Department of Agriculture has tested every dairy well and has the test data on file. This data is available to individual producers. It is highly recommended that this information be included as a part of the plan. The well name drop down box will have the names of those wells that were previously identified on the maps. Each well can be selected and the information entered specifically for the individual well. Enter as much of the information for each well as is available. Remember to identify the type of well. Examples of well types would include: agricultural, residential, commercial and stock water. Enter the date of the test of the well. It is highly advisable to maintain a list of the well tests to initially establish a baseline and as additional tests become available, to develop trend data. Should it be necessary to edit a test that was previously entered, first select the well for which the information should be edited and then select the date of the test you wish to edit from the Test Date drop box. Once the screen is populated with the test information, simply make the necessary changes.

Irrigation Induced Erosion

Irrigation induced erosion has an impact on the phosphorus index which is used in the calculations and nutrient application recommendations. The purpose of this "Tab" is to identify if the practices being used on an individual field are holding soil losses to an acceptable level. If levels of soil losses are at an excessive level, the planner can, in consultation with the producer, utilize conservation practices, which will help reduce soil losses with the goal of reducing losses to an acceptable level.

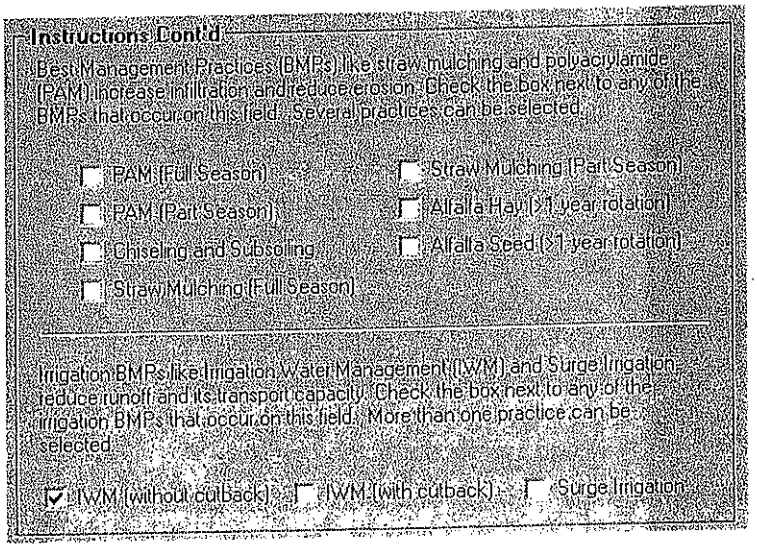


Selecting a field will also select the soils information pertinent to the selected field and that data will be taken into consideration in the calculation of soil losses. The GIS information also provides the Soil Erodibility factor (K), which is used in calculating total erosion in tons of soil per acre.

The planner will select tillage practices that are being used on the field to evaluate soil loss potential. The residue factors will affect the phosphorus index which in turn affects allowable application of nutrients.

Irrigation considerations include the slope of the field (user entered – in %), length of run, condition at the end of the furrows, and irrigation Best Management Practices that are being used. These items are entered by selecting the appropriate category from a drop box as seen in the example to the left.

Irrigation Best Management Practices



The "Irrigation – BMP's section of the screen will allow the planner to identify the practices being used that will help to reduce erosion.

Selecting PAM as an irrigation BMP, the use of conservation tillage practices and soil conserving crops as a part of the crop rotation will result in reduced erosion due to irrigation

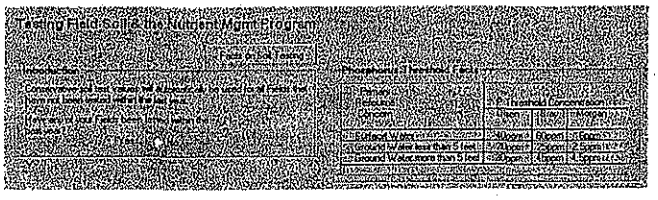
420

and impact the phosphorus index which is used in calculating allowable nutrient applications. The use of specific irrigation BMPs such as Irrigation Water Management and Surge Irrigation will also have an impact by reducing erosion. Select applicable BMPs by checking the appropriate check box for those applicable.

Soil Testing

Soil testing is the key to the whole nutrient management planning process. The objective to nutrient management planning is to provide the adequate nutrients for crop production, and at the same time, to insure that excessive nutrients are not applied or left in the soil where they can be leached into the ground water or eroded away into surface waters.

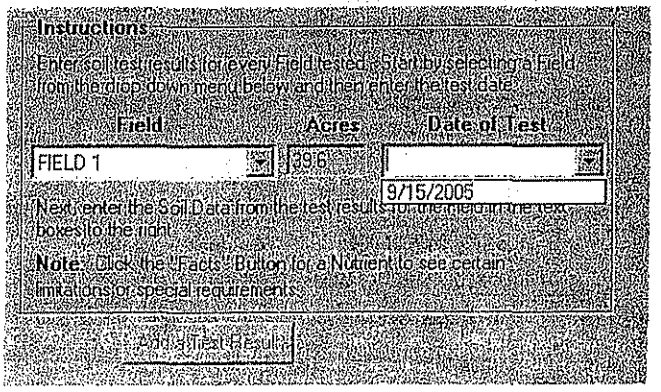
Proper sampling is critical to obtaining credible test results. Refer to the University of Idaho Soil Sampling Guide for the proper procedures in soil sampling to obtain a good sample.



Note: No nitrogen results can be given for those fields that have been tested more than 3 months (9 months for phosphorus) before the fertilizer application date (remember, this information was entered with the crop information as Date of Fertilization).

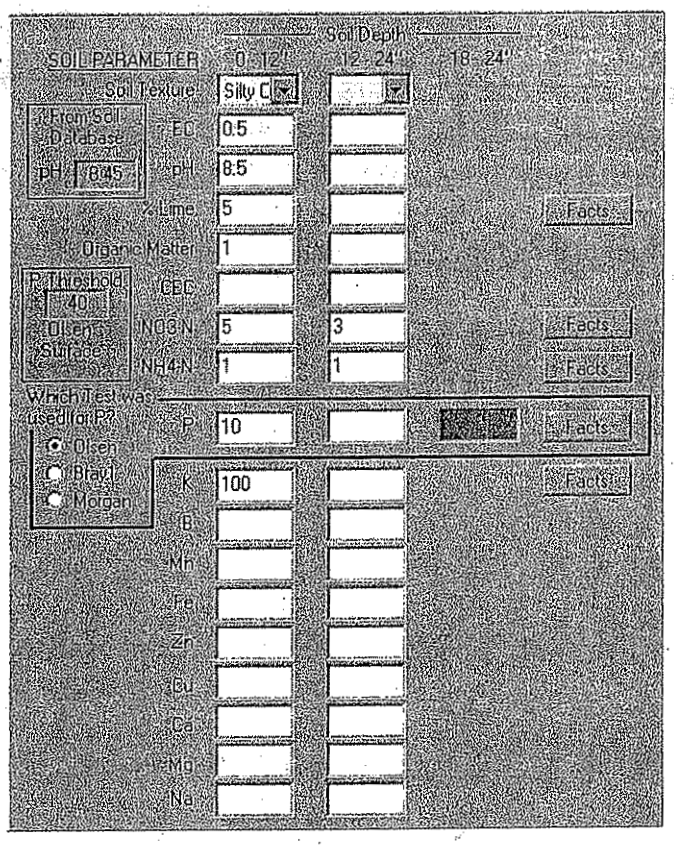
Selecting the "Yes" radio button will allow the user to enter the information for any of the fields on file. Soil test results should be entered on all fields. If some fields have not been tested, enter the results for those fields that have been done in the last year. Note that the Phosphorus Threshold levels are provided for reference.

Soil Test Data Entry



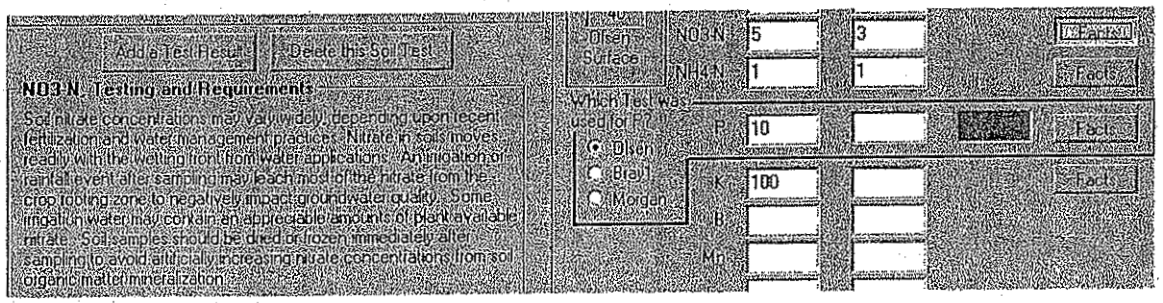
Regular (annual) testing is beneficial to establish baseline data and to build a history or to develop trends. The soil test entry screen allows the planner to compile a history of tests when multiple tests are entered for the selected field by using the "Add a Test Result" button. As many additional tests can be added for the selected field as the planner has available. This type of information will allow planners and producers to evaluate plans in the future to be able to fine tune plans to insure the environmental soundness of the plans being used.

The drop down box under "Field" allows the user to select from all fields on file for entry of a soil test. The date of the test must be filled in to identify one test from another. To edit an existing test simply select the field for which test you wish to modify from the drop box, next select the date of the test to be modified from the drop box and make the necessary changes on the data entry portion of the screen.



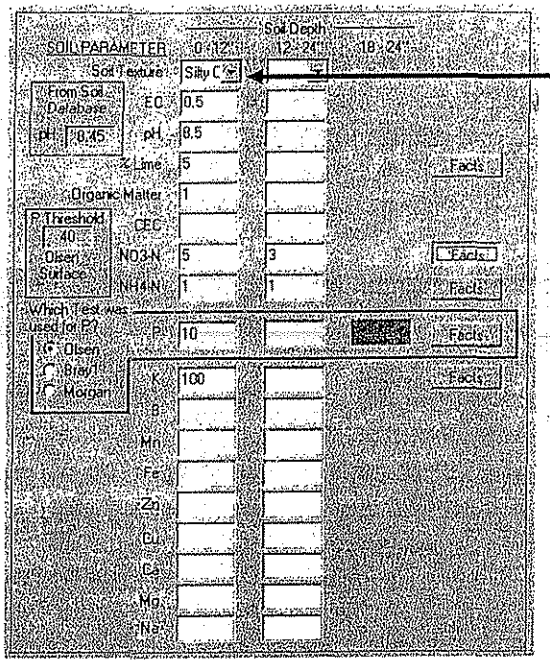
Note: Once again, data from the GIS layers is used in this section of the program. The soil database provides the expected pH for the soils in this field. The P threshold is displayed for this field based on the GIS layers, plus the previous information entered. **Also, note** that since the example is for a surface water runoff resource concern, the 40 ppm P threshold is in place, and soil test information will be from the 0"-12" and the 12"-24" levels. If a ground water resource concern was identified the P threshold would reflect the depth to ground water or the presence of a subsurface feature, and the soil test would ask for an addition P test in the 18"-23" levels.

Note: Nutrient lines with the fact buttons have information regarding the management or



regulation of that nutrient.

422



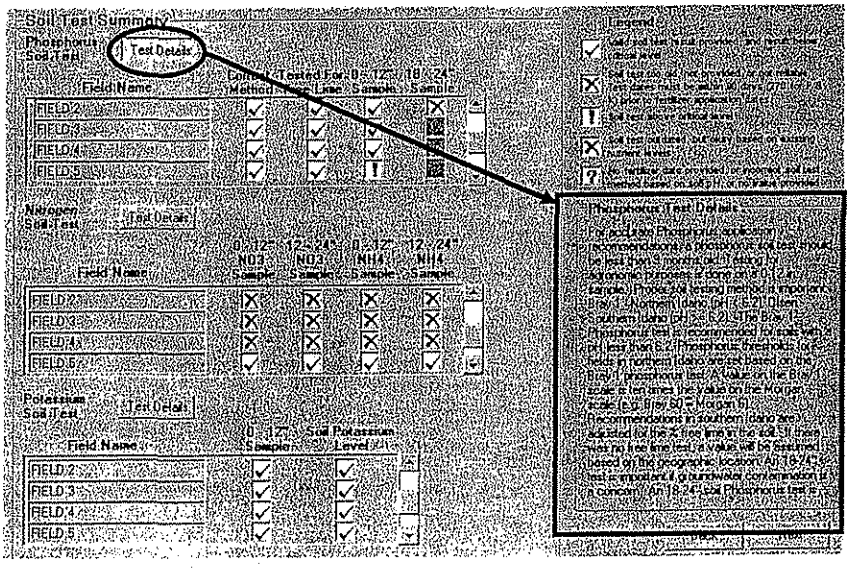
The soil test data entry screen requires the planner to identify the soil textures from the drop down box shown above for the 0-12" soil tests. If the texture is not listed on the soil test the planner can access texture data by opening the "Soil Characteristics" under the "Record" Tab.

The planner will enter any of the additional soil test information that is available. It is important that the planner identify the type of lab test that was used to determine the phosphorus reading since the correct type of test must be used based on soil pH.

If it is necessary to edit a previously entered soil test data, simply select the field and the date of the test and the data entry screen will contain the previously entered information. Simply enter the new information and the test has been updated.

Soil Test Summary

From this visual perspective, the planner can identify shortcomings in the soil-testing program. Items that have been provided by the test information entered is identified by the checks in the boxes. A checked ☑ item has either been entered and is in compliance with the testing requirements. Those items identified with an "☒" are not in compliance while those with an "❗" indicate that the soil test levels exceed allowable levels. A"❓" indicates that no date for fertilizer application was given or that an incorrect testing method was used for the phosphorus test. If the user has questions about a specific test, they can get further details by using the "**Test Details**" button.



423

Application of Nutrients to Cropland

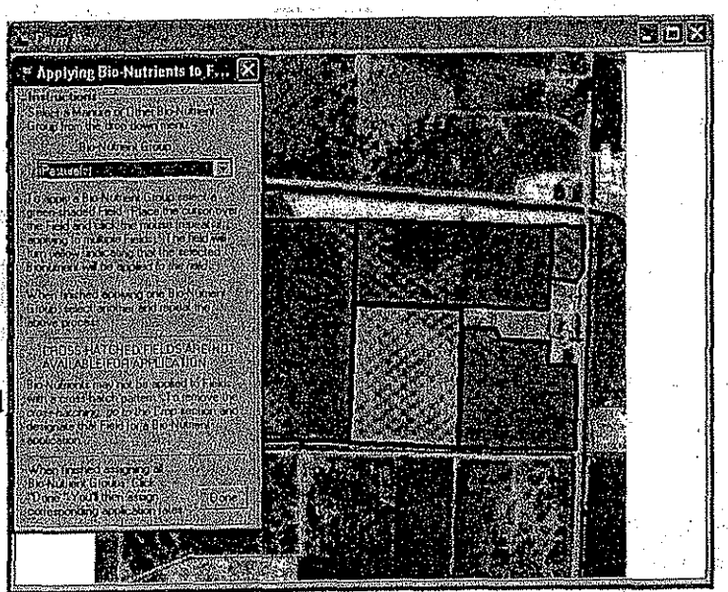
The application section of the program will lead the planner through the following tasks:

- Determine the crop nutrient requirements for each field based on the crop grown
- Quantify the existing and expected nutrient sources in a field
- Schedule the application of manure or other bio-nutrients to meet crop requirements
- Schedule commercial nutrients, if needed, to satisfy remaining crop needs
- Identify application methods and timing of nutrient application
- Report excess bio-nutrients which must be exported

Identification of Fields for Application

The first step in the application of Bio-nutrients will be the identification of the fields and the nutrient groups to be considered for each field in the application process.

First select the "Apply to Fields" button to begin assigning the fields that will receive Bionutrient applications. Select the group of Bionutrient you wish to apply and then simply click on the fields which will receive bio-nutrients.

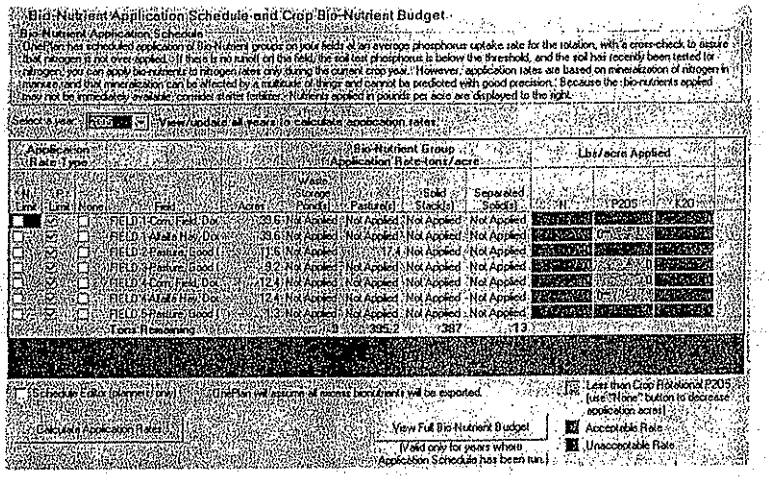


After all of the fields for a specific group have been selected the planner can select the next bio-nutrient group to apply. Simply repeat the process of selecting fields for the application until all bio-nutrient groups that will be applied have been selected.

Once the fields receiving bio-nutrients have been selected, the program displays a screen which identifies the Bio-nutrient Application Schedule and the Crop Bio-nutrient Budget. This summary can be displayed for any one of the years which are included in the plan.

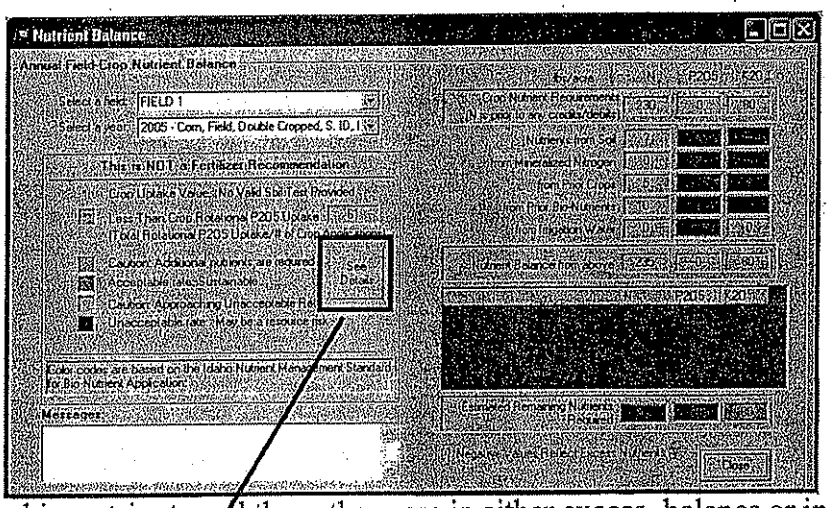
Bio-nutrient Application & Timing

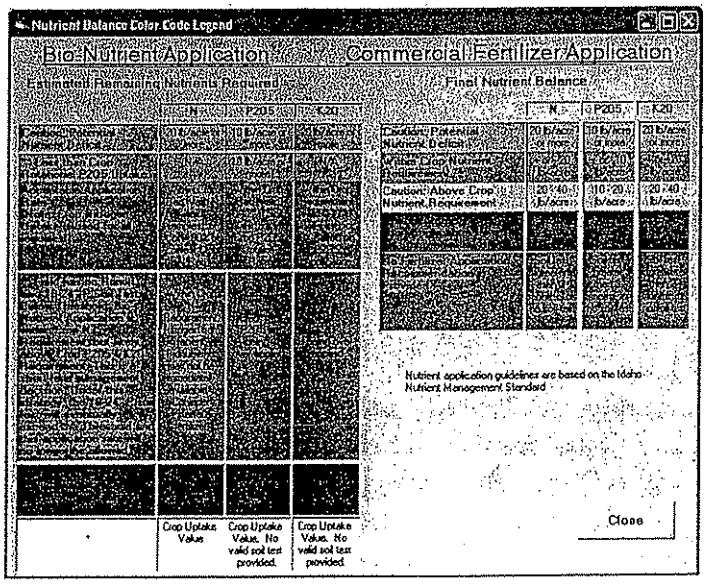
Once a year has been selected the planner can calculate the application rate necessary to meet crop uptake needs for the specific crops and in the specific fields. The calculation can be updated by pressing the "Calculate Application Rates" button found on the lower left corner of the screen. After the rates have been calculated the planner can "View Full Bio-Nutrient Budget" by pressing the button in the lower right hand corner of the screen.



Note: The nutrient balance table on the right side of the screen is populated. All of the acceptable parameters are green. Those fields where nutrient application rates exceed recommended levels are colored red. Those fields where bio-nutrients fail to meet the nutrient needs for crop production are shown in light blue. These fields will need additional bio-nutrients or commercial fertilizer if yield potentials are to be reached. Parameters identified by red must be corrected for the plan to become certified.

When the Annual Field-Crop Nutrient Balance is activated by pressing the "View Full Bio-Nutrient Budget" button planners can view the individual fields for a given year to obtain detailed nutrient information based on the recommend bio-nutrient application rates. The left side of the screen provides an evaluation of the nutrients taken up by the crop, those provided by bio-nutrients and those those are in either excess, balance or in deficit.





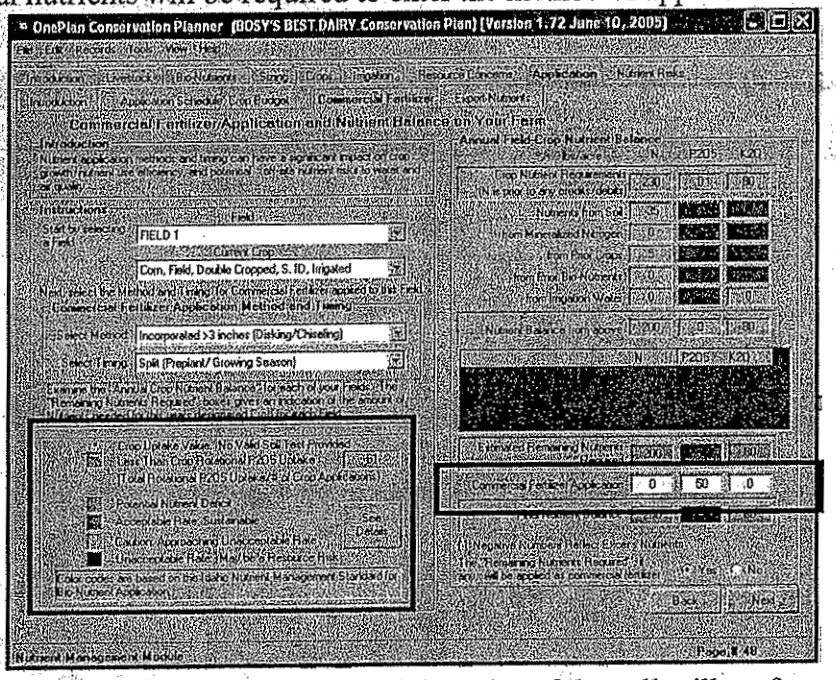
When the planner selects the "See Details" button, the screen to the left appears and provides planners with the details for the legends which are used to categorize bio-nutrients and nutrient balances. The parameters used to determine each of the categories blue, green, yellow, red and grey are explained.

425

Commercial Nutrient Application and Timing

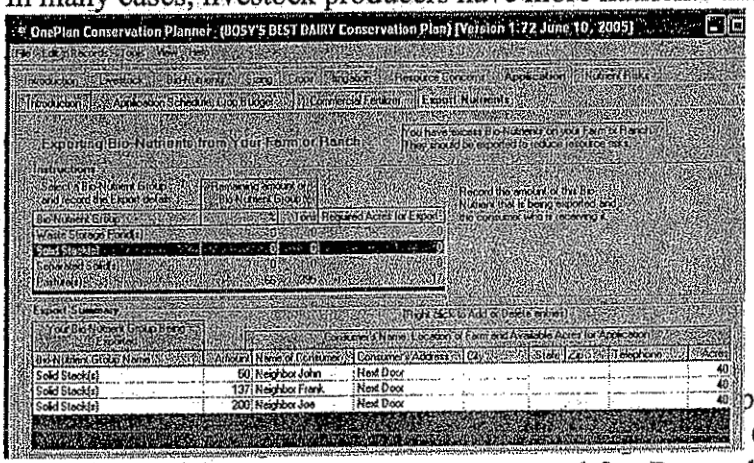
Commercial Nutrient Application & Timing

Planners using commercial nutrients will be required to enter the method of application and timing of application. Both the timing and application provide drop down boxes where the user selects the method, or the one that most closely describes the application and timing of application. The planner can enter the amount of commercial fertilizer being used in the box on the lower right side of the screen. **Note:** The balance is updated as the pounds of commercial fertilizer are entered. When excess commercial nutrients are added the color of the cell will go from blue which presents a potential nutrient deficiency to green which is acceptable levels then to yellow which is a cautionary level and finally to red which is an unacceptably high level of nutrients.



Exporting Nutrients

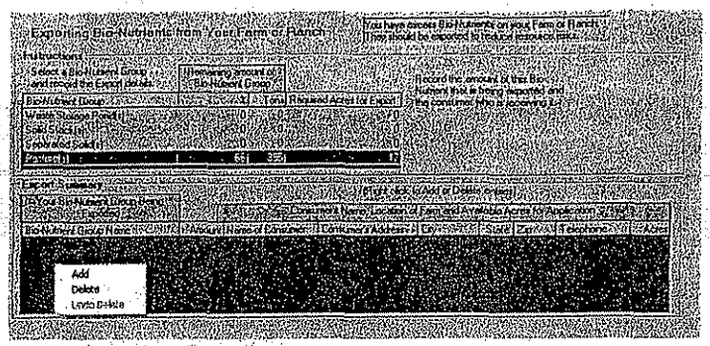
In many cases, livestock producers have more nutrients than they can utilize on their own cropland. Some producers may have agreements with other farmers who produce their feed. A producer will buy feed in exchange for the farmer taking manure. The nutrients to be exported must first be identified by bio-nutrient group and then assigned to producers who will be taking the nutrients to their farms. The farmers to



y completing the form shown Continue to add farms for exports until all of the nutrients are accounted for. Remember to account for all of the bio-nutrient groups. The plan is not considered complete until all excess nutrients from all groups have been accounted for. To assign the export of a bio-nutrient group the highlights

426

the bio-group and then moves the cursor to the gray area of the table and right click to activate the add, delete, undo delete dropdown box. Right click on the add option will Load the bio group to the export summary. The planner then can input the quantity, Customer information.



Note: The planner can add as many customers as necessary to export the Bio-nutrient group.

Nutrient Risk Analysis

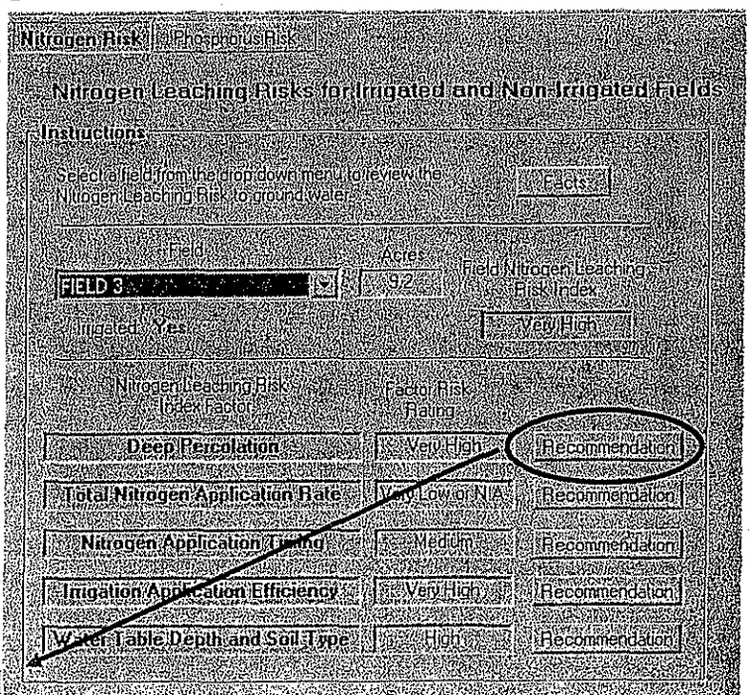
Once the application information has been completed, the final step in completing the plan will be to evaluate potential risks and to provide recommendations for minimizing the risks that have been identified. Each field has a list of risk index factors displayed for both nitrogen and phosphorus.

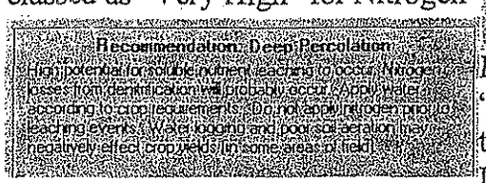
Nutrient Risk Analysis - Nitrogen

Once the application information has been completed, the final step in completing the plan will be to evaluate potential risks and to provide recommendations for minimizing the risks that have been identified.

Each field has a list of risk index factors displayed. In the example to the right the risk index for "Deep Percolation" and "Irrigation Application Efficiency" are both listed at "Very High."

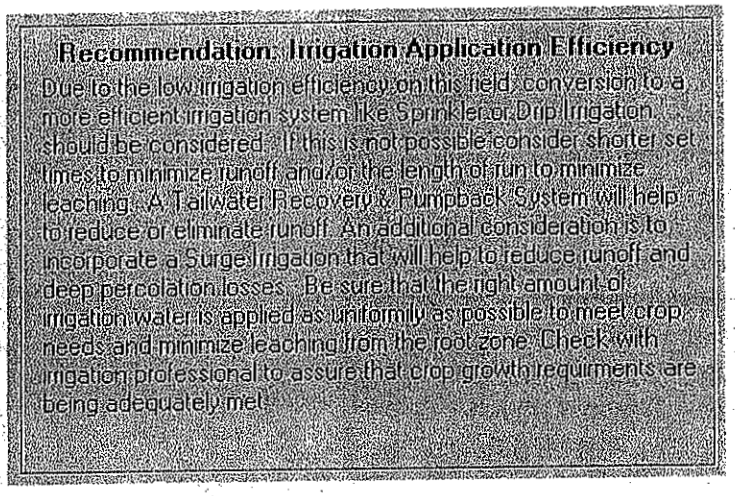
Note: as a result of the two very high ratings the entire field has been classed as "Very High" for Nitrogen Leaching Risk Index. The planner should use the "Recommendation" button to access the text entry box for that index and place recommendations for reducing the Irrigation Application Efficiency risks.





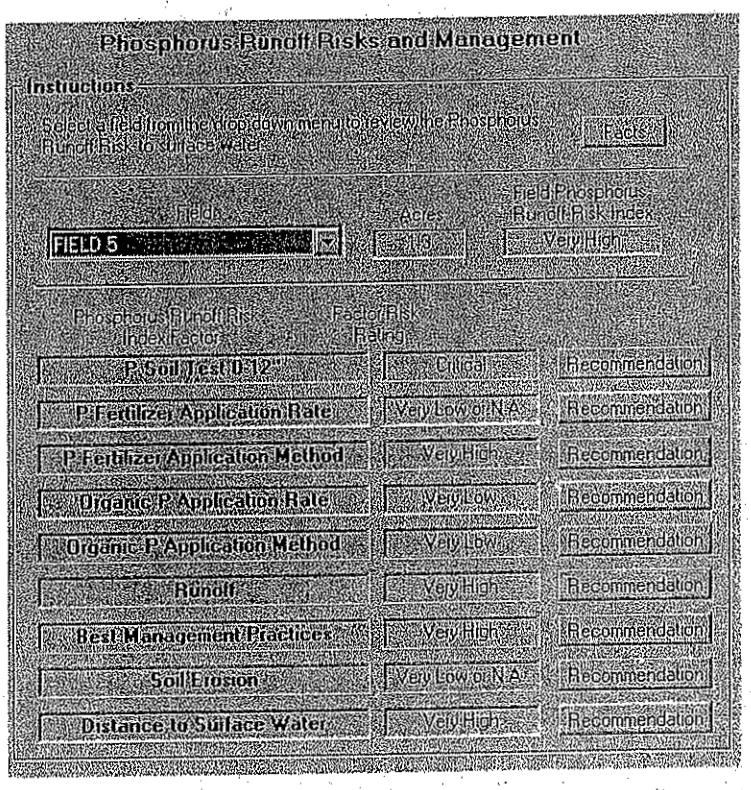
427

Note: The Recommendations for addressing the concern in Irrigation Application Efficiency are displayed to the right of the screen when the "Recommendation" button is pressed.



Nutrient Risk Analysis - Phosphorus

The phosphorus risk evaluation is similar to that used for nitrogen risk evaluation. There are several additional risk areas that are examined in relation to phosphorus runoff.



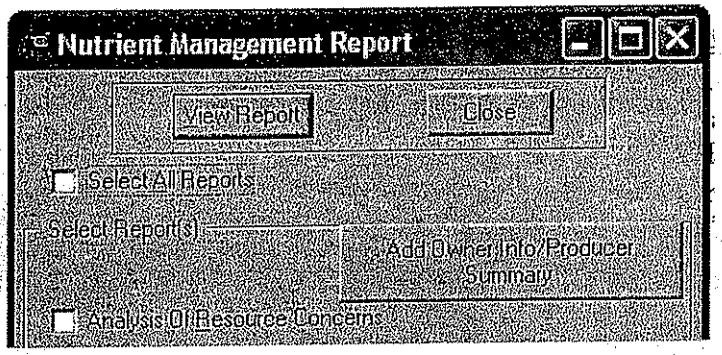
Each field has a list of risk Index factors displayed. In the example to the left, the risk index for "P Soil Test 0-12" is listed at "Critical." This level poses major cause for concern; the planner should use the "Recommendation" button to access the text box which will provide recommendations for dealing with the concern.

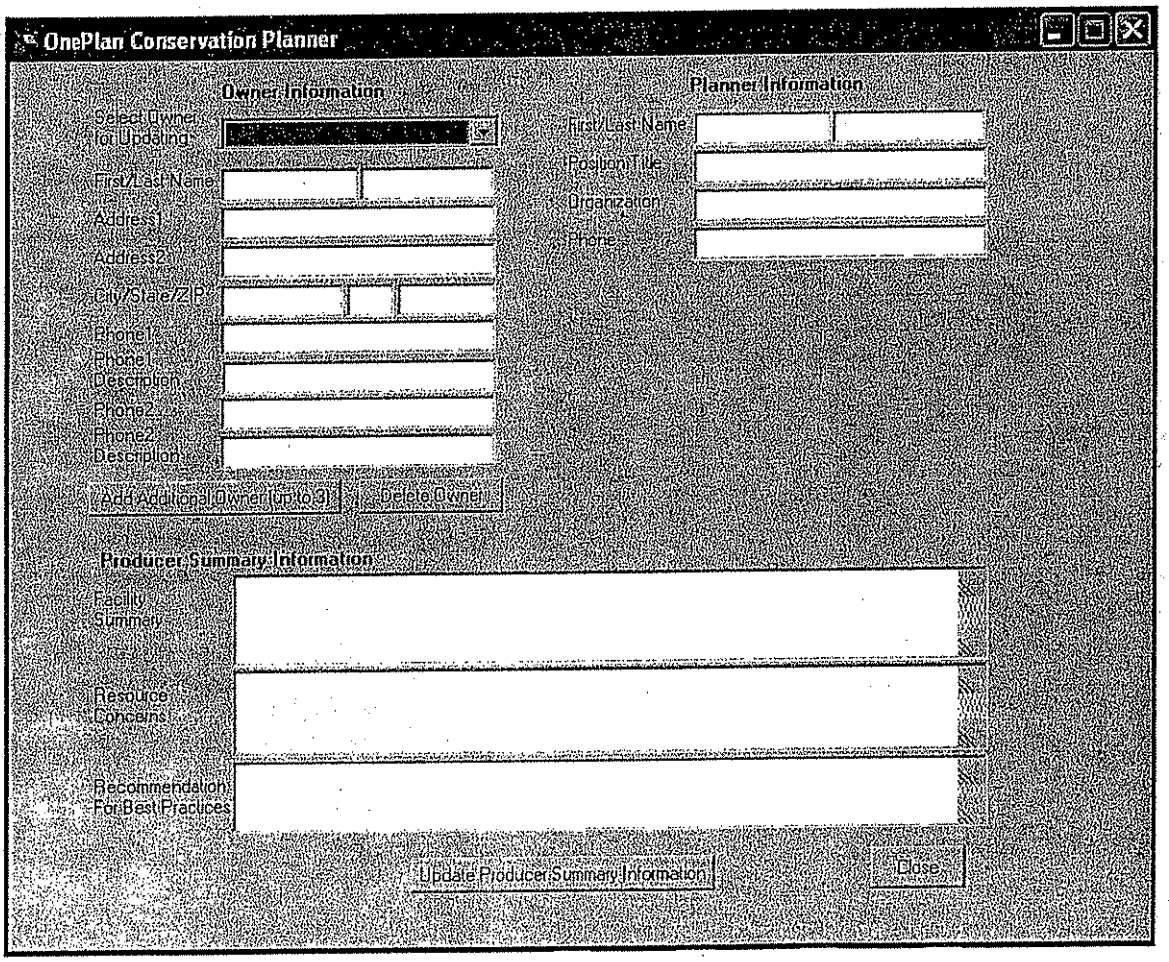
Note: Several categories are at the Very High level which places the entire field into the "Very High" Category.

428

Finishing the Plan

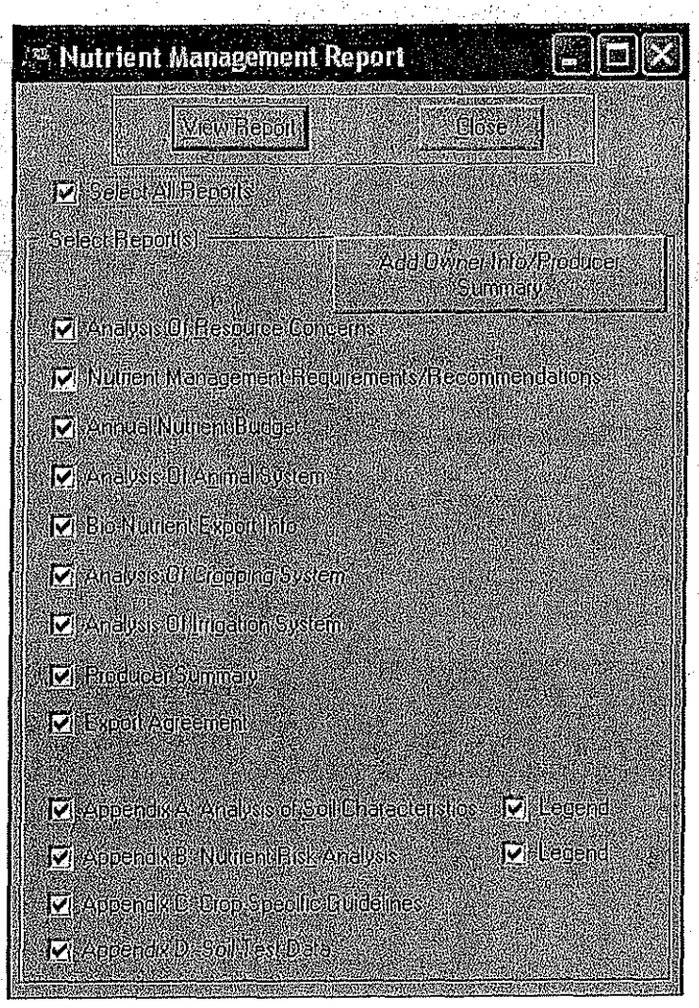
The data entry for the plan has now been completed. The final step is to provide the producer's name and address. The planner will also be required to enter their name and address. By clicking on the "Add Owner Info/Producer Summary" the following window will be activated.





429

Producing the Printed Plan



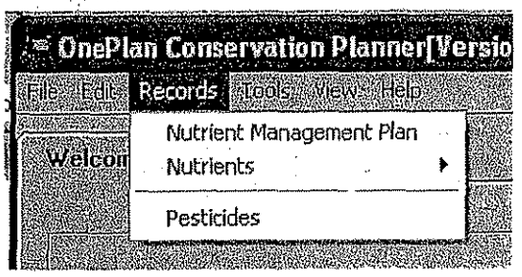
Once all of the data is input, the calculations have been made; the plan can be printed out. The printout can be of the entire report or any one or more of the individual components of the report.

The reports can be printed to a printer, a file or to a special program such as a PDF writer. The print out may be 70 – 110 pages in length and may occupy a slow printer for a long time.

Records

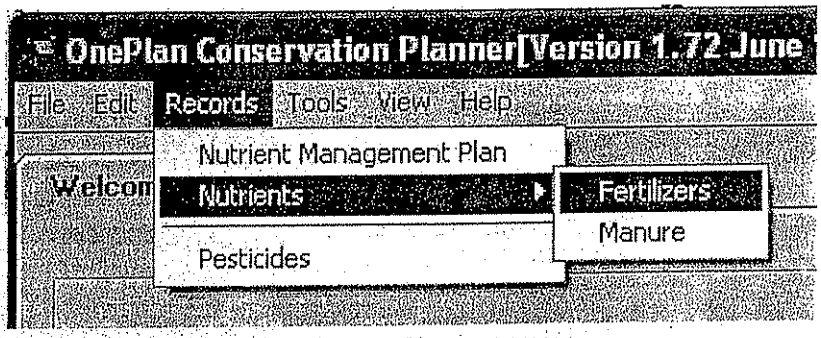
The records tab contains the links to three important items.

Nutrient Management Plan
Nutrients
Pesticides

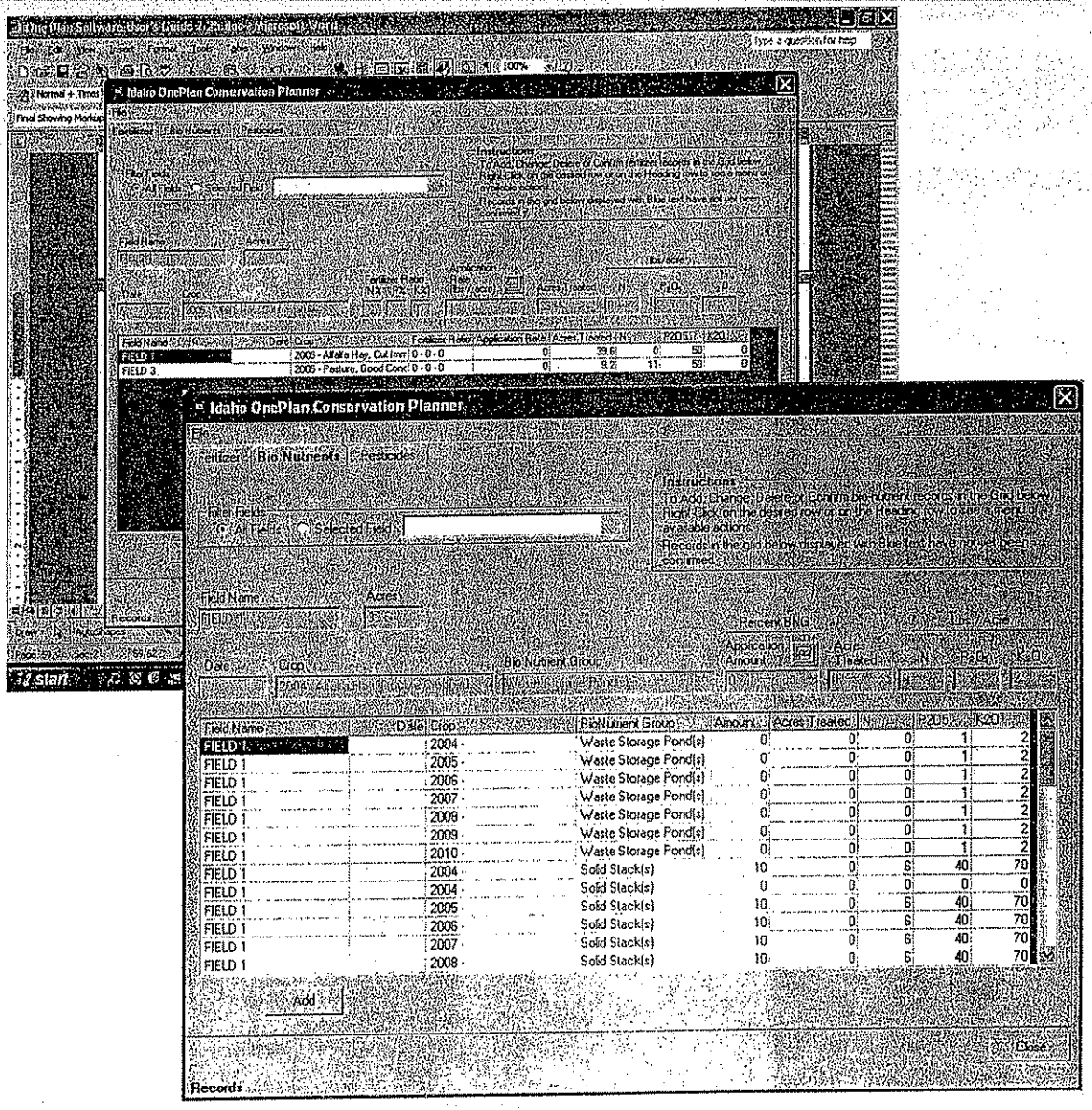


The Nutrient Management Plan will give the planner a printout of the plan report. This is the a way of gaining access to the report without having to navigate the program.

430



The Nutrient option gives the planner access to the history of application of nutrients whether applied in the form a bio-nutrients (manure waste) or commercial fertilizer.



The Pesticides option will give the planner the same historical database when the IMP module to OnePlan is developed.

431

Plan Record Keeping/Reviewing

Nutrient management plans are required to be reviewed annually either by the producer, his or her representative, or by ISDA or NRCS agencies for the purpose of meeting the regulatory requirement or program requirement in co-operation with producer. All Nutrient Management Practices should be well documented/recorded in order to meet these requirements.

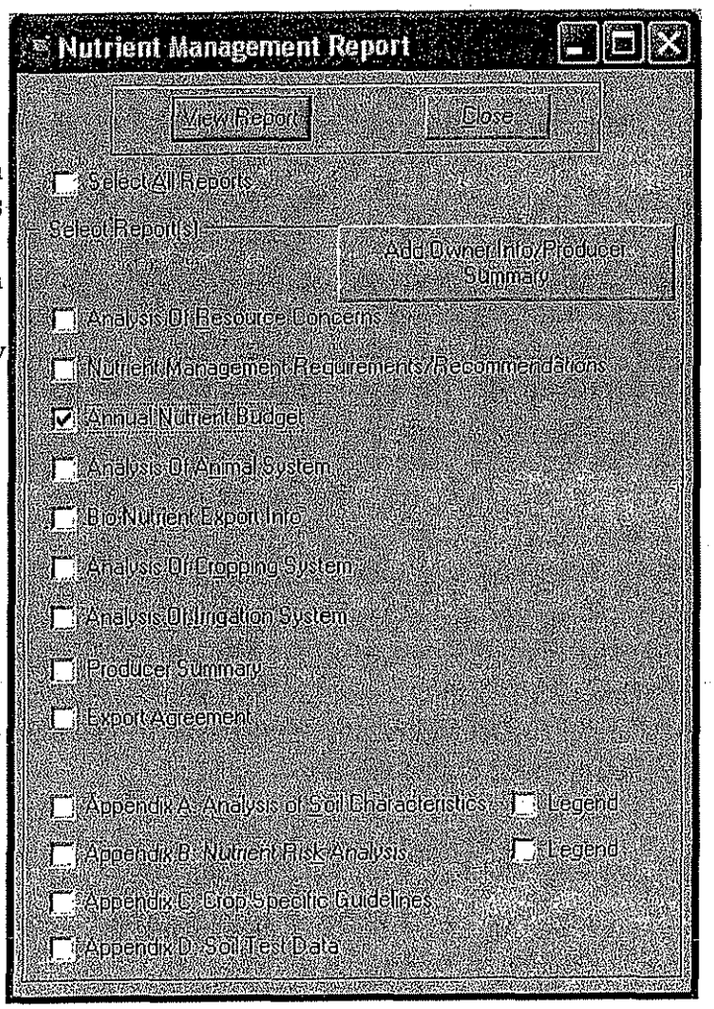
Nutrient Management Plan needs re-written for:

1. Increase in herd size >10%
2. major changes in waste handling
3. changes in crops or crop rotation
4. change in the size of application areas
5. changes in irrigation system

Annual Nutrient Budget

Annual Nutrient Budgets (ANBs) are required under NRCS Nutrient Management Standard (590) as adopted. OnePlan has been designed to assist the planner in development of the ANB. On 1 November each fall the programs roles ahead to the next planning years. In this process the planner or reviewer will then be required to verify the crop in the rotation, enter new fertilizer dates, verify irrigation practice and enter the new soil test information for each field in the CNMP.

To print the ANBs the planner then proceeds to the "Nutrient Management Report" tab and print the "Annual Nutrient Budget".



IRRIGATION MANAGEMENT PLAN REQUIREMENTS

Enter all required upgrades or changes in irrigation management. Example, required changes are:

- If a field is currently a surface water concern, and the plan is written as if the field is a groundwater resource concern (the plan states a sprinkler system will be installed).
- If the producer is over-applying animal waste and the planner will require irrigation set times.

FACILITY TESTING REQUIREMENTS

Input the following statement:

Regulatory soil phosphorus samples are required from each field every 3-5 years. Samples will be taken from the 0-12" soil depth for surface water concerns and the 18-24" soil depth for groundwater concerns. The samples will be reviewed for phosphorus level and compared with previous test data. These tests will indicate compliance with the nutrient management plan. The producer is not responsible to take or analyze these samples. Refer the producer to the Field Threshold Table in Resource Concern section of the One Plan NMP printout for the individual field's resource concern and phosphorus threshold.

RECOMMENDATIONS

Provide recommendations to upgrade storage and handling, nutrient management, and irrigation management on the facility. Include site-specific Best Management Practices that would improve nutrient management, irrigation, and waste management practices.

Discussion of AFO/CAFO Rules

Gary McRae
U.S. Environmental Protection Agency

EPA

NRCS

ISDA

DEQ

Summary

Federal Regulations

- EPA CAFO Regulations
  - NPDES Permits – National Pollution Discharge Elimination System Permits

State Regulations

- Dairy Waste Rules – IDAPA 02.04.14
- Beef Cattle AFO Rules – IDAPA 02.04.15
- Dead Animal Rules – IDAPA 02.04.17
- Odor Management Rules – IDAPA 02.04.16

EPA CAFO/AFO Requirements

What is a CAFO?

- First, you must meet the definition of an AFO
- AFO - Animal Feeding Operation
  - Confines animals for 45 days in any 12 month period
  - Sustains no vegetation in confinement area
- Concentrated Animal Feeding Operation (CAFO)
  - 3 size classes – Large, Medium, Small

AFO = CAFO If…

- A "Large-size" facility consists of
  - ≥ 700 mature dairy cows, 1,000 beef cattle,…
- A "Medium-size" facility consists of
  - 200-699 mature dairy cows, 300-999 beef cattle,… *and*
  - Discharged to waters of the US
- A "Small-size" facility consists of
  - < 200 mature dairy cows, 300 beef cattle,… *and*
  - Has been previously inspected
  - Discharged to waters of the US
  - Designated

"Large" CAFOs

Dairy Cows	700 (Mature)
Beef Cattle	1,000
Heifers, Veal Calves	1,000
Swine	2,500 (55 lbs or more) 10,000 (under 55 lbs)
Horses	500
Sheep or Lambs	10,000
Turkeys	55,000
Chickens, liquid manure	30,000
Chickens, other than a liquid manure system	125,000 (not laying hens) 82,000 (laying hens)

"Medium" CAFOs

Dairy Cows	200-699 (Mature)
Beef Cattle	300-999
Heifers, Veal Calves	300-999
Swine	750 - 2,499 (55 lbs or more) 3,000 - 9,999 (under 55 lbs)
Horses	150 - 499
Sheep or Lambs	3,000 - 9,999
Turkeys	16,500 - 54,999
Chickens, liquid manure	9,000 - 29,999
Chickens, other than a liquid manure system	37,500 -124,999 (not laying hens) 25,000 - 81,999 (laying hens)

+ discharged to waters of the US
[illegible] manmade conveyance

"Small" CAFOs

Dairy Cows	< 200 (Mature)
Beef Cattle	< 300
Heifers, Veal Calves	< 300
Swine	< 750 (55 lbs or more) < 3,000 (under 55 lbs)
Horses	< 150
Sheep or Lambs	< 3,000
Turkeys	< 16,500
Chickens, liquid manure	< 9,000
Chickens, other than a liquid manure system	< 37,500 (not laying hens) < 25,000 (laying hens)

+ previously inspected / + discharged to waters of the US / + designated as "CAFO" man made convergence

The Steps

- If you are not sure if you are a CAFO, then contact EPA Region 10 at (208) 378-5765
- If you apply for a NPDES permit then you must comply with permit requirements

Requirements within a NPDES Permit

- Nutrient management plan must be developed and implemented by?
- The nutrient management plan must:
  - Ensure adequate storage of manure, litter and process wastewater
  - Ensure proper management of mortalities
  - Ensure diversion of clean water
  - Prevent direct contact of confined animals with waters of the US
  - Ensure chemicals and other contaminants are not disposed of in any manure, litter or process wastewater

U28

Requirements within a NPDES Permit (cont.)

- Identify site-specific conservation practices
- Identify protocols for testing of manure, litter, process wastewater and soil
- Establish protocols to land apply manure, litter or process wastewater in accordance with site-specific nutrient management practices; and
- Identify specific records that document the implementation of elements described above.

Requirements within a NPDES Permit (cont.)

- Record keeping requirements
  - Maintain all applicable records for five years
  - Nutrient management plan must be maintained on site and available to Director upon request
  - Additional record keeping requirements for Large CAFOs
- Transfer of manure
  - Records (date, recipient name and address, amount of manure,...) must be retained for five years
  - Large CAFOs must provide recipient of manure with current nutrient analysis

Requirements within a NPDES Permit (cont.)

- Annual Reporting Requirements
  - Annual report submitted to Director
    - Number and type of animals
    - Estimated amount of manure generated in previous 12 months
    - Estimated amount of manure transferred to other parties in previous 12 months
    - Total number of acres for land application
    - ...

1139

Final Take Home on NPDES Permit Requirements

- Idaho will receive a single general permit from EPA for the State
- This permit will outline all final, specific requirements that Beef and Dairy producers will need to comply with
- We expect this permit at anytime…..

More information

- **CAFO regulations and outreach materials:**
  - www.epa.gov/npdes/caforule
- **Compliance assistance:**
  - www.epa.gov/agriculture
- ***USDA programs:***
  - www.usda.gov
- **EPA Idaho Operations Office:**
  - (208) 378-5765

ISDA Waste Regulations for Dairies

- No discharge allowed – defined as solid or liquid manure leaving the property of the facility
- Must have 180-day containment of process waste water
- Containment structures must be approved by ISDA
- Waste application must be made in accordance with the facility's NMP
  - NMP will specify site-specific time frames for liquid land application
- Facility must keep records of:
  - Manure and commercial fertilizer applications
    - Must include Field, Date, Type and Amount
  - Mandatory record keeping of third party exported manure
    - Who, address and amount
    - Nutrient Management Plans

Nutrient Management Plans

- Plans are designed to meet either
  - Crop phosphorous uptake or
  - Crop nitrogen needs
- All plans designed to meet crop phosphorous uptake will not meet crop nitrogen needs
  - These plans will require supplemental commercial nitrogen to meet crop nitrogen requirements
- Plans designed for crop nitrogen needs only for underdeveloped soils with low phosphorous content
- Idaho OnePlan tool

Nutrient Management Plans

- Manure Nutrient Value can be determined by calculations from published book values or by manure testing
- Manure application rates are determined from soil tests, current crop needs and crop rotation.

ISDA Goals for Dairy NMP's

- Every facility to have a completed NMP by July 1, 2001 - Done
- All dairy plans must be approved by ISDA – 767 Dairy plans, Done June 2004
- Compliance schedules must also be approved by ISDA/Dairy Bureau

NMP Regulatory Program

- NMP Requirements
  - Mandatory spring soil testing for nutrient budgeting purposes
  - Mandatory record keeping of manure and commercial fertilizer applications
    - Must include Field, Date, Type and Amount
  - Mandatory record keeping of third party exported manure
    - Who, address and amount
- All records must be available to ISDA inspection staff during normal business hours

Effluent Application Timing

- Effluent should only be applied to actively growing crops
- Some limited applications allowed on field stubble for breakdown of straw
- No application on snow covered ground
- No application during winter storage period
- Facility must contact ISDA prior to early spring applications before the start of the regular irrigation season (April 15th)

Beef Program

- Similar to Dairy Program with the following exceptions:
  - Only CAFO's are regulated
    - 1,000-head operations or those operations that discharge to waters of the US fall under EPA's definition of CAFO
  - Require 120-day containment
  - Discharge only if waste reaches waters of the US
  - NMP's are required of existing operations by January 1, 2005
  - NMP's are required before new operations are used

1/12

Odor Regulation

- 2001 Legislative session drafted the Agriculture Odor Management Act
  - Title 37 – Chapter 25
- Rules Governing Agriculture Odor Management
  - IDAPA 02.04.16
- Regulatory Authority given to ISDA
- Law and Rules are on the second revision
- Policy to be presented by June 2004

Agriculture Odor Management Act

- Scope of the law and rules
  - Covers all agricultural operations
    - Except…
      - Beef Cattle Feeding Operations - Typically >= 1,000 head
      - Large Swine and Poultry Operations > 2,000 AU
  - Facilities must not emit odors in excess of those normally associated with accepted Agricultural Practices in Idaho
    - A facility found to exceed this level would be issued a Notice of Violation (NOV)
      - Facility must then develop and implement an Odor Management Plan

Questions?

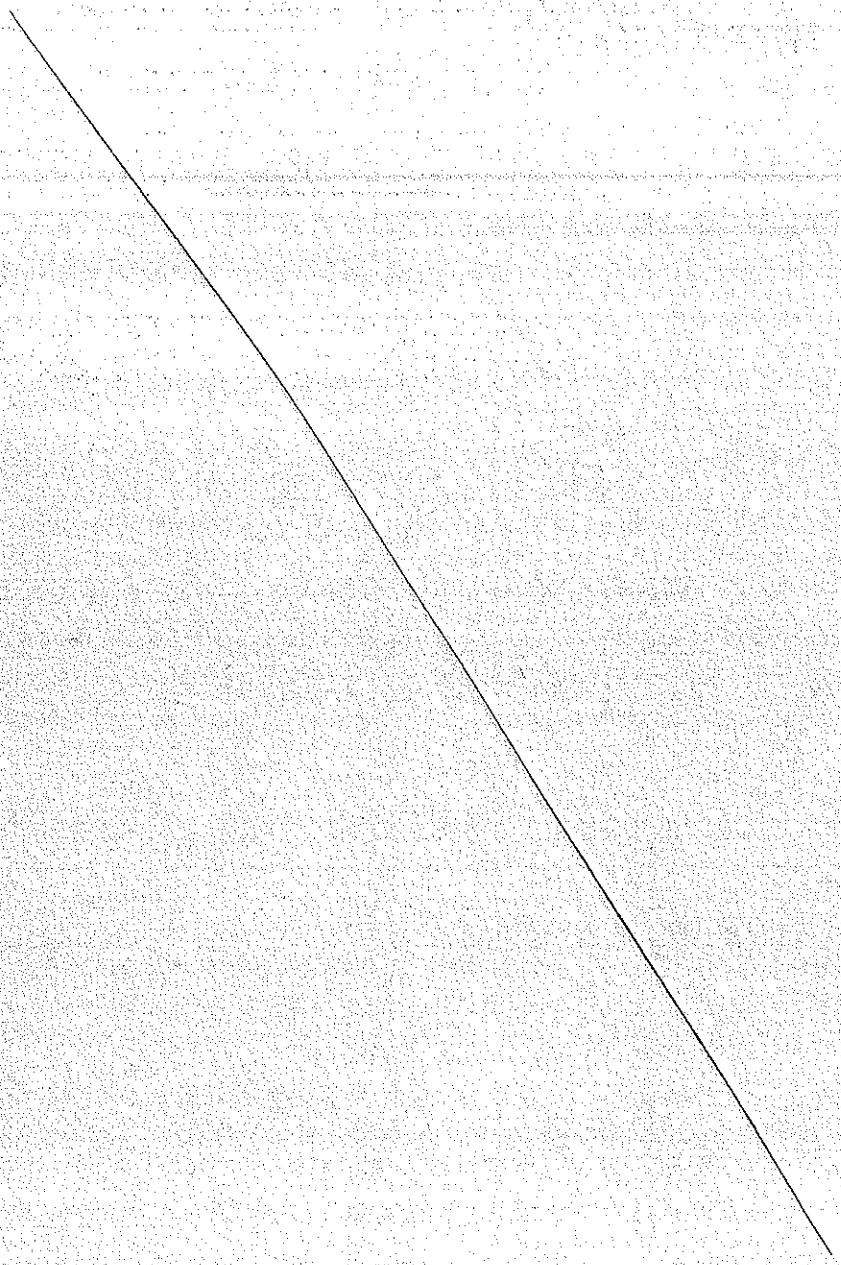
EPA

ISDA

DEQ

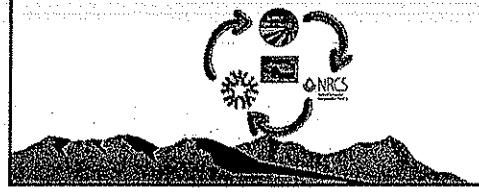
NRCS

4W3



NRCS Nutrient Management Standard (590)

Dick Johnson,
Nutrient Management Specialist
USDA, Natural Resource Conservation Service



Current Version

- Nutrient Management Conservation Practice Standard - Code 590
  - Released June of 1999
  - Current Version: December 2004

How Do I Get a Current Version of Idaho 590 Standard?

- www.nrcs.usda.gov
  - Takes you to the NRCS National Home Page
- Important: Locate the map of the US and click on Idaho
- Click on any county in Idaho (suggest Ada)
- Left column displays sections of the electronic Field Office Technical Guide (eFOTG); click on Section IV
- Click on Idaho Conservation Practices
- Scroll down to Nutrient Management, then click on it
- Download it, save or print

415

Use of Practice Standards

- Voluntarily
  - Conservation Plans – Farmers & Ranchers
- Regulatory
  - Idaho Department of Agriculture
    - Idaho Waste Management Guidelines
      - Dairies
      - AFOs/CAFOs
- Adoption by some counties' Planning & Zoning Boards

Conservation Practice Standards

- Basis for conservation planning
- Basis for cost sharing
  - Practices must be planned and applied according to its standard
  - If not, then:
    - Not eligible for cost sharing
    - Does not meet state law
- Basis for meeting state law

Conservation Practice Standards
Cont'd.

- If a TSP persistently/knowingly develops NMPs that do not meet 590, certification can be revoked.

446

Conservation Practice Standard 590 KEY POINTS

Definition

- Managing the amount, source, placement, form, and timing of the application of nutrients and soil amendments
  - Compost is considered a soil amendment
  - Slurry is considered a liquid

Conditions Where Practice Applies

- This practice applies to all agricultural lands where plant nutrients and soil amendments are applied.

Nutrient Budgets

- Developed using:
  - U of I Fertilizer Guides
  - Crop uptake
  - NRCS Idaho Waste Management Field Handbook
  - NRCS Idaho Animal Waste Management Program

Realistic Yield Goals

- Determined for all crops in the nutrient management plan
- Proven yield by the producer
- Achievable yield goals for the area including advancements in technology

Phosphorous Threshold (TH)

- Two Purposes:
  - Determine method waste applications can be made:
    - Crop uptake
    - Recommended rate (UI Fertilizer Guides)
    - To determine trends in soil P concentrations over time
  - Track changes in P concentrations (Regulatory)

448

What Is TH?

- Soil test concentration of Phosphorus above which there is no agronomic crop response
  - Potatoes have the highest P uptake
- Key Terms
  - Soil Test P (Plant Available)
  - Agronomic response

Where Did The TH Come From?

- Result of discussions by industry, agency, and university personnel during development of the standard

Additional Practices Required

- Irrigation Water Management
  - Runoff
  - Deep percolation
  - Balance nutrient management with IWM
- Practices shown as necessary by the P Risk Analysis
  - Reduce off site transport of P

Soil Sampling For Nutrient Budgets

- Procedure:
  - Samples taken according to UI, CES Bulletin No. 704
    - 15 - 20 samples consolidated into 1 representative sample per field
- Samples must be taken at the 1' & 2' depths
  - Exception: UI Fertilizer Guides = 1' for *SOME* crops

Soil Sampling – Nutrient Budget

- Taken Annually!
- Taken on each field where nutrients are applied
  - Exception: More than 1 field with:
    - Same soil
    - Same crop rotation
    - Same existing crop
    - Same previous crop

Soil Sampling – Nutrient Budget

- Nitrogen
  - ✓within 90 days of majority of Application
- Phosphorus and Potassium
  - ✓within 9 months of majority of Application
    - N, P & K
      - Taken in the spring for a spring seeded crop
      - In the fall for a fall seeded crop, or
      - In the spring following a fall seeded crop where majority of N will be applied in the spring

Laboratory Analysis

- Soil sample analysis will be performed by a laboratory participating in the North American Proficiency Testing – Performance Assessment Program (NAPT-PAP)

Idaho Standard 590

Soil Sampling and Laboratory Analysis

✓Reference Table 1

Depth [1]	Nutrient Analyzed
Northern Idaho 0 - 12 inches	NO_3-N, NH_4-N, P, & K, % soil organic matter, pH
12 - 24 inches	NO_3-N [2]
Southern Idaho 0 - 12 inches	NO_3-N, NH_4-N, P, & K, % soil organic matter, pH, % free lime
12 - 24 inches	NO_3-N, NH_4-N

1 Follow specific fertilizer guide requirements for depth of soil samples. Some guides do not require soil samples to be taken at both the 1st and 2nd foot depths.
2 Northern Idaho: Testing for NH4-N in the second foot is recommended in the UI Fertilizer guides but not required.

Laboratory Analysis Procedures

- pH greater than 6.5: Olson
  - Southern Idaho
- pH less than 6.5: Bray I, Morgan
  - Northern Idaho
- Output:
  - N values in ppm **NOT lbs**

Soil Sampling – To Determine TH P

- Taken any time during the year
  - Reason:
    - P Is not readily mobile
    - Concentration in the soil changes slowly over time
    - Therefore, gives a clearer indication of whether ppm is staying the same, increasing, or decreasing
    - N soil test & budget is still needed

Soil Samples – To Determine TH P

- Two conditions to consider:
  - Surface water resource concern
  - Ground water resource concern

In 590 / OnePlan

- Surface water resource concern
  - Runoff from any source
  - 1st foot
- Ground water resource concern
  - No surface runoff
  - Percolation could occur
  - 18 – 24 inches

Idaho Standard 590 CRITERIA

Table 3

Primary Resource Concern		
Surface Water: Seasonal or Irrigation induced off-field runoff		
	40 ppm	60 ppm
Ground Water: high water table, fractured bedrock, poor irrigation water management, cobbles, gravels		
< 5 feet	20 ppm	25 ppm
> 5 feet	30 ppm	45 ppm

The Olsen test can be used on land units with pH values above and below 8.5; however, when pH is > 8.5 use the Olsen evaluation.
Use Bray-I or Morgan when soil pH is < 6.5.

Plant Tissue Testing

- Tissue sampling and testing is recommended

Nutrient Application Rates

- For animal waste:
  - **P crop uptake**, balance for **N**, UI Guides

  UNLESS
  - Application at **P uptake** would over apply **N**

  THEN
  - Balance for **N & P** – UI Guides

In no case is over-application of N allowed!

Nutrient Application Rates

- For Commercial Fertilizer
  - Application based on University of Idaho Fertilizer Guides

Nutrient Application Timing

- Application of solid wastes
  - Fall / Spring
  - Incorporation recommended
    - Potential runoff
    - Losses of N
- If application is made on snow / frozen soils:
  - Prevent runoff
    - Tillage
    - Berms
    - Dikes

Nutrient Application Timing

- Liquid Wastes (Includes slurry)
  - Apply during active growth period
  - Acceptation: Water budget shows that runoff or deep percolation will not occur
  - Application through irrigation systems
    - Sprinkler application recommended
    - Surface system application not recommended
      - Time mixing of waste with irrigation water to prevent runoff or deep percolation

Nutrient Application Timing

- Commercial fertilizer
  - Fall applied N:
    - Soil temperatures < 50° F
    - With a nitrification inhibitor
    - With controlled release

Phosphorous Transport Risk Analysis

- Used as an assessment tool to identify environmentally-vulnerable or sensitive areas
- Determine when additional practices are needed

Considerations

- Considerations are recommendations, not requirements
- Change from fertilizer guides to crop uptake when TH reaches 75%

Plans and Specifications

- Identifies required components of the plan
- Certified NMP is the "Specification", it defines:
  - Dairy Bureau specific requirements
  - Criteria of 590

Operation & Maintenance

- Nutrient budget are developed annually
  - Producer
  - Their representative
- Annual reviewers need not be certified
  - Basic training

Operation & Maintenance

- Revise the nutrient management plan when significant changes occur:
  - Increase in herd size
  - Major changes in waste handling
  - Changes in crops or crop rotation
  - Change in the size of application areas
  - Changes in irrigation system
  - Designation of sensitive areas

Field Level Records

- Field level records required:
  - Soil test results
  - Nutrient budget generated from OnePlan

Questions?

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

NUTRIENT MANAGEMENT

(Acre)

CODE 590

DEFINITION

Managing the amount, source, placement, form, and timing of the application of nutrients and soil amendments.

PURPOSES

It is intended that nutrient management plans developed from this standard be used to help producers improve or maintain their level of management and expertise as it relates to the application of nutrients on the lands they own and/or control.

- To budget and supply nutrients for plant production.
- To minimize the potential for environmental damage including agricultural non-point source pollution of surface and ground water resources.
- To maintain or improve the physical, chemical and biological condition of soil.
- To properly utilize all sources of organic material, including animal waste, as a plant nutrient source.
- To prevent or reduce excess nutrient concentrations in the soil.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all lands where plant nutrients and soil amendments are applied. Soil amendments include composted animal waste.

CRITERIA

General Criteria Applicable to All Purposes.

Nutrient Management Plans (NMPs) shall comply with all applicable federal, state and local laws and regulations.

NMPs that address land application of animal waste shall comply with the State of Idaho Waste Management Guidelines for Confined Feeding Operations.

NMPs shall be developed in accordance with policy requirements of the NRCS General Manual Title 450, Part 401.03 (Technical Guides, Policy and Responsibilities) and Title 190, Part 402 (Ecological Sciences, Nutrient Management, Policy); technical requirements of the NRCS Field Office Technical Guide (FOTG); procedures contained in the National Planning Procedures Handbook (NPPH) and the NRCS National Agronomy Manual (NAM), Section 503.

Persons who approve plans for nutrient management shall be certified through the joint Idaho State Department of Agriculture, NRCS, and University of Idaho (U of I) certification program, or other acceptable program as designated by the State Conservationist.

If nutrients are applied on an annual basis, annual soil samples shall be taken and an annual nutrient budget developed in order to develop and maintain NMPs. Refer to other sections in the standard.

A nutrient budget for nitrogen (N), phosphorus (P), and potassium (K) shall be developed that considers all potential sources of nutrients including, but not limited to, animal waste, composted animal waste, other composted by-products, and organic by-products, waste water, commercial fertilizer, crop residues, legume credits, and irrigation water.

Nutrient Management Plans based upon application of commercial fertilizer only.

Nutrient budgets based upon applications of commercial fertilizer only shall follow the University of Idaho Fertilizer Guides, (Fertilizer Guides) or crop specific Production Guides.

Budgets will not be developed for crops that do not have Fertilizer Guides.

Nutrient Management Plans which include application of animal waste.

Nutrient budgets which include application of animal waste shall be based upon the Phosphorus Threshold (TH) as discussed in this

standard. Budgets shall be based upon:

- Tables, values and guides generated from Idaho OnePlan Nutrient Management Program or other NRCS approved programs.
- Values contained in the NRCS Agricultural Waste Management Field Handbook, Chapters 4 and 6.
- Use data from laboratory analysis of waste, when available.

Phosphorus Threshold (TH)

The P TH is used in the nutrient budgeting process when land application of animal waste is included. It is used:

- To determine the method for developing the nutrient budget, which could be crop uptake or recommended application rate cited in the Fertilizer Guides.
- To track trends in soil P concentrations over time.
- The TH is the soil test P concentration above which there is no agronomic response to additional applications of P for crops grown in Idaho or for which there is a high probability of P leaching.
- A soil test P concentration is a chemical evaluation of the capability of the soil, as represented by a soil sample, to supply adequate plant available P during the growing season for optimum growth.
- The nutrient budget is developed using Fertilizer Guide recommendations or Crop Uptake if soil test P concentrations are equal to or less than the designated threshold (TH).
- The nutrient budget is developed using Crop Uptake estimates if soil test phosphorus concentrations are greater than the designated TH.

Nutrient Management Plans

Plans shall be based upon realistic yield goals for the crops included in the crop rotation evaluated.

Plans shall specify the form (liquid, gas or solid), source (dairy, feedlot, commercial fertilizer, etc.), amount, timing, and method of application of nutrients on each field or Conservation Management Unit (CMU) to achieve realistic production goals, while minimizing N and/or P movement to surface and/or ground water.

Crop rotations shall be documented in the nutrient management plan.

Irrigation Water Management (449) shall be a component of a nutrient management plan if nutrients are applied on irrigated pasture, hayland or cropland.

The Phosphorus Transport Risk Analysis Tool shall be used to determine if additional conservation practices will be required to prevent off-site movement of P. Off-site movement is defined as movement of P off the field or management unit or downward through the soil profile beyond the root zone.

Soil Sampling and Laboratory Analysis

Soil samples shall be collected and prepared such that they are representative of the entire field or portion of the field to be managed separately. (See U of I CES NO. 704, Soil Sampling).

Exception: Precision agriculture techniques where grid sampling is utilized to develop nutrient management units within a field.

Soil sample analysis will be performed by a laboratory that is successfully meeting the requirements and performance standards of the North American Proficiency Testing – Performance Assessment Program (NAPT-PAP).

Laboratory analysis shall include components shown below and in Table 1.

- South Idaho Fertilizer Guides, (Irrigated Cropland): First foot sample shall include NO_3-N, NH_4-N, P, K, % soil organic matter, pH, and % free lime. The producer or their representative may want the analysis to include additional elements. The analysis for the second foot shall include NO_3-N and NH_4-N.
- Northern Idaho Fertilizer Guides (generally Non-Irrigated Cropland): First foot sample shall include NO_3-N, NH_4-N, P, K, % soil organic matter and pH. The producer or their representative may want the analysis to include additional elements. The analysis for the second foot shall include NO_3-N.

Soil samples will be analyzed for P using the test methods utilized in the development of the Fertilizer Guides. For example, the Northern Idaho Fertilizer Guide for Winter Wheat uses the Bray-1 or Morgan (sodium acetate) tests on soils with a pH less than 6.2 or the Olsen (sodium bicarbonate) test for soils with pH greater than 6.2. However, the Southern Idaho Fertilizer Guides for Winter Wheat utilizes only the Olsen test.

Soil Sampling - Development of the Initial Nutrient Management Plan

Soil samples are taken annually on each field for which a nutrient budget is developed, or as prescribed by specific Fertilizer Guides.

For soil sample and starter fertilizer applications:

- Soil samples are not required when a starter application of less than or equal to 20 pounds N and/or 20 pounds P_2O_5 are applied. Soil samples will be required if additional nutrients are applied.
- The North Idaho Winter Wheat Fertilizer Guide includes an alternative P application scenario which accounts for additional P applications when the following crop is peas or lentils. If this alternative is used, then the starter application discussed above is not allowed.

A composite soil sample may be taken which represents several fields under the following conditions. Fields being grouped into one Conservation Management Unit (CMU) must:

- Have the same predominate soil type.
- Be in the same crop rotation.
- Have the same previous crop.
- Have the same current crop.
- The composite soil sample must be representative of all fields in the CMU.

Soil sampling taken for the purpose of developing the annual nutrient budget must be taken no earlier than 3 months prior to applying the bulk of the fertilizer for the designated crop(s).

Soil tests can be taken at any time of the year to determine the concentration of P for comparison to the TH.

Depth of soil samples. Soil samples taken for purposes of developing the nutrient budget shall be taken as described in Table 1 or the appropriate Fertilizer Guide.

Table 1

Depth [1]	Nutrient Analyzed
Northern Idaho 0 - 12 inches [1]	NO_3-N, NH_4-N, P, & K, % soil organic matter, pH
12 - 24 inches	NO_3-N [2]
Southern Idaho 0-12 inches [1]	NO_3-N, NH_4-N, P, & K, % soil organic matter, pH, % free lime
12 - 24 inches	NO_3-N, NH_4-N

[1] Follow specific fertilizer guide requirements for depth of soil samples. Some guides do not require soil samples to be taken at both the 1st and 2nd foot depths.

[2] Northern Idaho: Testing for NH4-N in the second foot is recommended in the UI Fertilizer guides but not required.

Accounting for nitrogen in the root zone. North Idaho Fertilizer Guides recommends sampling to the 3rd and/or 4th foot for some crops. If the laboratory analysis provides this data, account for it in the nutrient budget.

Soil samples taken for comparison to the P threshold will be taken at the depth shown in Table 2, dependent upon the on-site surface or ground water resource concern.

- Surface water concerns exist when surface runoff leaves field(s) from precipitation, rain on snow or frozen ground, or irrigation.
- Ground water concerns exist when surface water (from any source) does not leave the field. A high water table, fractured bedrock, poor irrigation water management, cobbles, gravel or coarse-textured soils can contribute to downward movement of water and nutrients.

Table 2

Primary Resource Concern	P Threshold Soil Sample Depth
Surface Water	0" – 12"
Ground Water	18" – 24"

When considering soil P threshold levels, a surface water resource concern has priority over a groundwater concern. When neither resource concern is present, the nutrient management

plan is developed based on the TH for the ground water concern in order to prevent concentrations of nutrients above the agronomic requirement of the crop, and to maintain soil quality and long-term sustainability of the cropland resource.

To meet local nutrient requirements as identified in the fertilizer guide, the 0" – 12" soil sample can be used to determine other diagnostic needs.

Fields that are part of a non-irrigated cropland rotation that includes summer fallow do not have to be soil sampled the year the field(s) are in summer fallow.

Non-inversion cropping systems (i.e., no till or direct seeding systems) or areas where resource problems dictate closer management may require soil samples in zones less than 0" - 12".

In situations where specialty crops are raised or environmental considerations have been identified (high water tables, leaching vulnerability, tile drains, fractured bedrock, deep or shallow soils), sampling greater than or less than the prescribed depths may be appropriate. The NRCS soil survey data is sufficient to make this determination unless site-specific conditions vary substantially from the survey. The production system and environmental considerations will determine soil-sampling depth. Soil samples will represent the field or CMU being planned.

Phosphorus TH concentrations by resource concern are listed in Table 3. Use the primary resource concern identified and site characteristics to determine the TH of the site.

Table 3

Primary Resource Concern	P Threshold Concentration		
	Olsen	Bray-1	Morgan
Surface Water	40 ppm	60 ppm	6 ppm
Ground Water			
< 5 feet	20 ppm	25 ppm	2.5 ppm
> 5 feet	30 ppm	45 ppm	4.5 ppm

The Olsen test can be used on land units with pH values above and below 6.2; however, when pH is > 6.2 use the Olsen evaluation. Use Bray-I or Morgan when soil pH is < 6.2.

Fields that are part of a long term sod, pasture, or alfalfa crops in rotation, may not require annual soil samples if nutrients are not applied on a regular basis. Soil samples are to be taken when nutrients will be applied as part of an on-going management program.

Soil sampling – Maintenance of the Nutrient Management Plan

For purposes of maintaining a developed NMP, soil samples and nutrient budgets will use as previously described.

For purposes of tracking P trends, soil samples will be taken and analyzed as described in Tables 2 and 3.

Soil samples for tracking changes in soil test P will be taken at the end of the crop rotation period where waste application was made.

Plant Tissue Testing

Tissue sampling and testing is recommended during the growing season to monitor crop nutrient concentrations.

Tissue sampling shall be done in accordance with University of Idaho guidelines or the guidelines of the laboratory performing the tissue analysis.

Nutrient Application Rates – Developing the Nutrient Budget

Reference "Nutrient Application Timing" for additional criteria concerning timing of applications which include N.

N application rates will be determined for each crop in the rotation.

P application rates will be determined for a single crop or for the crop rotation. Table 4 outlines the P application rates based on soil sample P concentrations as compared to the site TH for P applications that include land application of animal waste.

Table 4	
Soil Test P	**P Application Rate**
Surface Water < TH (ppm)	Fertilizer Guide P rate, or Crop P uptake.
> TH (ppm)[1]	Crop P uptake If land application of animal waste is included, the N applied as animal waste can not exceed the N requirement of the crop.
Ground Water < TH (ppm)	Fertilizer Guide P rate, or Crop uptake.
> TH (ppm)[1]	Fertilizer guide P rate, or Crop P uptake not to exceed *the N requirement of the* crop. If land application of animal waste is included, the N applied as animal waste can not exceed the N requirement of the crop.

[1] **Note: When soil test P concentrations are above the TH, the planner, in cooperation with the producer, will design a nutrient management plan that will reduce soil test P concentrations below the TH and minimize potential off-site transport. This may require adjustments in crop rotation, irrigation method and scheduling, form, timing or placement of P applied, and changes in P application rates less than crop P uptake.**

K applications shall not cause unacceptable nutrient imbalance in crops and forage quality or cause K shortages to limit crop growth and sustainability.

Nutrient applications are recommended when plant tissue tests indicate a need for nutrient application to correct or prevent a deficiency.

Calibrate waste and fertilizer application equipment to ensure recommended rates are applied.

Nutrient Application Timing

Application of solid wastes. Solid waste shall be *incorporated unless applications are made on* frozen ground, perennial crops or cropland under no-till; in those cases, emergency tillage (i.e., chiseling and disking cross slope), construction of berms or other containment practices will be applied to prevent surface runoff.

Winter application of solids on 0 – 2% slope fields can be considered if it is determined there is no potential for runoff.

Fall and winter application of solid wastes on shallow and/or sandy soils should be made when soil temperatures are <50 ° F to *minimize nitrification.*

Application of liquid wastes. Application of liquid waste shall not be made outside the active crop growing period, unless a site specific water budget shows that deep percolation of wastewater or runoff will not occur prior to the next crop-growing season. For purposes of this standard, animal waste in the slurry form will be managed as a liquid. Liquid waste shall be applied to crops at amounts not exceeding soil water holding capacity in the crop-rooting zone.

Application of liquid wastes through surface or sprinkler irrigation systems will be timed to prevent deep percolation or runoff. The number of applications will be based on the volume of waste to be disposed of as well as related concerns with surface runoff and deep percolation.

Application of commercial fertilizer. Commercial fertilizer applications shall be timed to provide for residue decomposition and crop production needs while avoiding surface runoff and leaching.

Reference "Nutrient Application Timing" for additional criteria concerning timing of applications which include N.

Criteria Applicable to Utilizing Organic Waste Resources as a Plant Nutrient Source.

Organic biosolids, (i.e., waste from food processing facilities), shall be applied as prescribed by federal, state, or local regulations.

Criteria for Maintenance or Improvement of Physical, Chemical or Biological Condition of Soil.

Biosolids, other than animal waste, and sewage sludge shall be applied as prescribed by federal, state, or local regulations (40 CFR parts 403 and 503).

Records of application and chemical

462

composition of biosolids must be maintained as required by the state.

Additional Criteria to Protect Water Quality on Vulnerable Sites.

Vulnerable sites are:

- Areas of average annual precipitation greater than 24 inches.
- Coarse textured soils and/or areas with high water tables (perched water less than 24 inches) with average annual precipitation greater than 21 inches or under irrigation.
- Idaho Nitrate Priority Areas and the 303d list which identifies nutrient impaired stream segments.

Reference UI Fertilizer Guides section "Water Quality Considerations" or sections which address N movement in soils. Specific guidance is provided in the Fertilizer Guides for application of N in high precipitation areas, or on irrigated crops. Follow the Fertilizer guides when addressing movement of N in the soil profile.

All fields or CMUs included in the NMP will be evaluated using the Phosphorus Transport Risk Analysis Tool. Resource and or environmental concerns identified by the analysis will be addressed with inclusion of needed conservation practices to address the concern.

Utilize nutrient timing, source and placement to reduce N and P pollution of ground and surface waters. Special consideration will be given to application and placement of nutrients on sensitive areas (i.e., Highly Erodible Lands (HEL), within flood plains, near sensitive water bodies, in areas of ground water contamination within sole source aquifers, wellhead protection areas, or within other areas of water quality concern).

In areas of special consideration, methods will include:

- Application of nutrients to crop fields to avoid or reduce potential of transport to gullies, ditches, surface inlets, sinkhole areas, or wellhead areas.
- No application of animal waste on sites where runoff is delivered directly to a conveyance channel or receiving water body unless runoff is treated with a conservation buffer or other mitigating practice prior to delivery.

In areas of special consideration, recommended methods may include:

- Split fall/spring applications utilizing soil temperatures (<50 ° F), nitrification inhibitors, or time release fertilizers, or split spring applications of N to provide nutrients at the times of maximum crop uptake.
- Band or place applications of P near the seed row.
- Incorporate broadcast nutrients.
- Farm on the contour or cross slope on all non-irrigated fields adjacent to wetlands if nutrient runoff appears to pose a more significant hazard than leaching.
- Utilize fall cover crops whenever possible to immobilize excess residual N and retain for spring crops.
- Use Cover (327), Residue Management (329A, B or C), Conservation Crop Rotation (328), Grassed Waterway (412), Irrigation Water Management (449), Riparian Forest Buffers (391), Filter Strips (393), Fencing (382), Watering Facility (614), etc., as needed to protect or improve water quality.

CONSIDERATIONS

Individual conservation practices should be planned as part of a comprehensive conservation plan, which addresses all resource concerns on the unit and reaches a Resource Management System level of treatment.

Rotations included in a nutrient management plan should meet the criteria of the Conservation Practice Standard Conservation Crop Rotation 328.

When soil test P concentrations approach 75% of the TH, consider developing the nutrient management plan using application rates at crop P uptake or less. At 75% of TH, concentrations of P are approaching the TH and management changes should be implemented.

Vary the amount of fertilizer in different parts of the field to account for differing yield potential, fertilizer needs and the potential for leaching and runoff.
Consider applying liquid wastes mixed with irrigation water during the last 1/4 to 1/3 of the irrigation set to minimize deep percolation and runoff.

Consider split applications to provide N at the time of maximum crop utilization, especially on

fall-seeded crops.

Consider routine mineral and nitrate N status testing of forages produced from land with long term and/or heavy waste application rates. Excessive soil K can lead to high K levels in forages, especially legumes like alfalfa, produced for livestock. Excess K intake by cattle is associated with decreased magnesium absorption, decreased feed intake and milk production, increased intake of water, and increased urine output. High dietary levels of K are a major concern in dairy herds. Plants with high levels of K and low levels of magnesium can cause grass tetany, a non-infectious metabolic disease in cattle.

Consider limited application of organic materials with high heavy metal concentrations.

Consider analyzing products from industrial processing used as fertilizer or soil amendments for heavy metals or other contaminants to prevent their buildup in the soil.

Consider cover crops whenever possible to utilize and recycle excessive residual N.

Band applications of P near the seed row.

Applying nutrient materials uniformly or as prescribed by precision agricultural techniques.

Delaying field application of animal wastes or other organic by-products, if precipitation capable of producing runoff and erosion is forecast within 24 hours of the time of the planned application.

Consider the potential problems from odors associated with the land application of animal wastes, especially when applied near or upwind of residences.

Consider N volatilization losses associated with the land application of animal wastes. Volatilization losses can become significant if wastes are not immediately incorporated into the soil after application.

PLANS AND SPECIFICATIONS

Plans and specifications shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose(s), using nutrients to achieve production goals and to prevent or minimize water quality impairment.
The following components shall be included in the nutrient management plan:

- Aerial site photograph or map and a soil map.
- Current and/or planned plant production sequence or crop rotation.
- *Results of soil, plant, water and* organic sample analyses.
- Realistic yield goals for the crops in the rotation.
- Quantification of all nutrient sources.
- Recommended nutrient rates, timing, and method of application and incorporation.
- Location of designated sensitive *areas or resources and the* associated practices or methods planned to protect the area.
- Guidance for implementation, operation and maintenance of the nutrient management component of the conservation plan.
- Complete nutrient budget for N, P, and K for the rotation or crop sequence.

When nutrient management plans are expected to increase soil P concentrations, such that concentrations approach the TH, plans shall include:

- A caution that P accumulation in the soil can occur and that the potential for such accumulation can contribute to water quality impairment, animal health or crop production problems.
- A discussion of the time interval after which it may be necessary to convert to P based waste or nutrient application rates for plan implementation.
- The potential for soil phosphorous drawdown from the production and harvesting of crops.

OPERATION AND MAINTENANCE

Nutrient Management Plan Review and Revision

The owner/client is responsible for safe operation and maintenance of this practice including all equipment. Operation and maintenance addresses the following:

Nutrient management plans shall be reviewed annually by the nutrient management planner to determine if adjustments or modifications are needed. Annual reviewers, including the producer, need not be certified.

The nutrient management planner shall revise the plan, as needed, to reflect significant changes in the operation that affect the overall nutrient management plan or upon change in landowner or tenant. Significant changes may include:

- increase in livestock by 10%;
- major changes to waste handling and storage system;
- increase or decrease in application area by 10%;
- change in crop or crop rotation;
- change in irrigation system;
- new designation as a sensitive area.

Safety

Protect fertilizer and organic by-product storage facilities from weather and accidental leakage or spillage. Storage of manure, fertilizers and cleaning of application equipment should be done away from a wellhead.

Calibrate application equipment to ensure uniform distribution of material at planned rates.

Backflow protection devices shall be installed according to Idaho chemigation requirements when using irrigation systems for application or distribution of liquid waste or commercial fertilizer.

Workers should be protected from and avoid unnecessary contact with chemical fertilizers and organic by-products. Protection should include the use of protective clothing when working with plant nutrients. Extra caution must be taken when handling ammonia sources of nutrients, or when dealing with organic wastes stored in unventilated enclosures.

The disposal of material generated from cleaning nutrient application equipment should be stored and disposed of properly. Excess material should be collected and stored, or field applied in an appropriate manner. Excess material should not be applied on areas of high potential risk for runoff and leaching.

The disposal or recycling of nutrient containers should be done according to state and local guidelines or regulations.

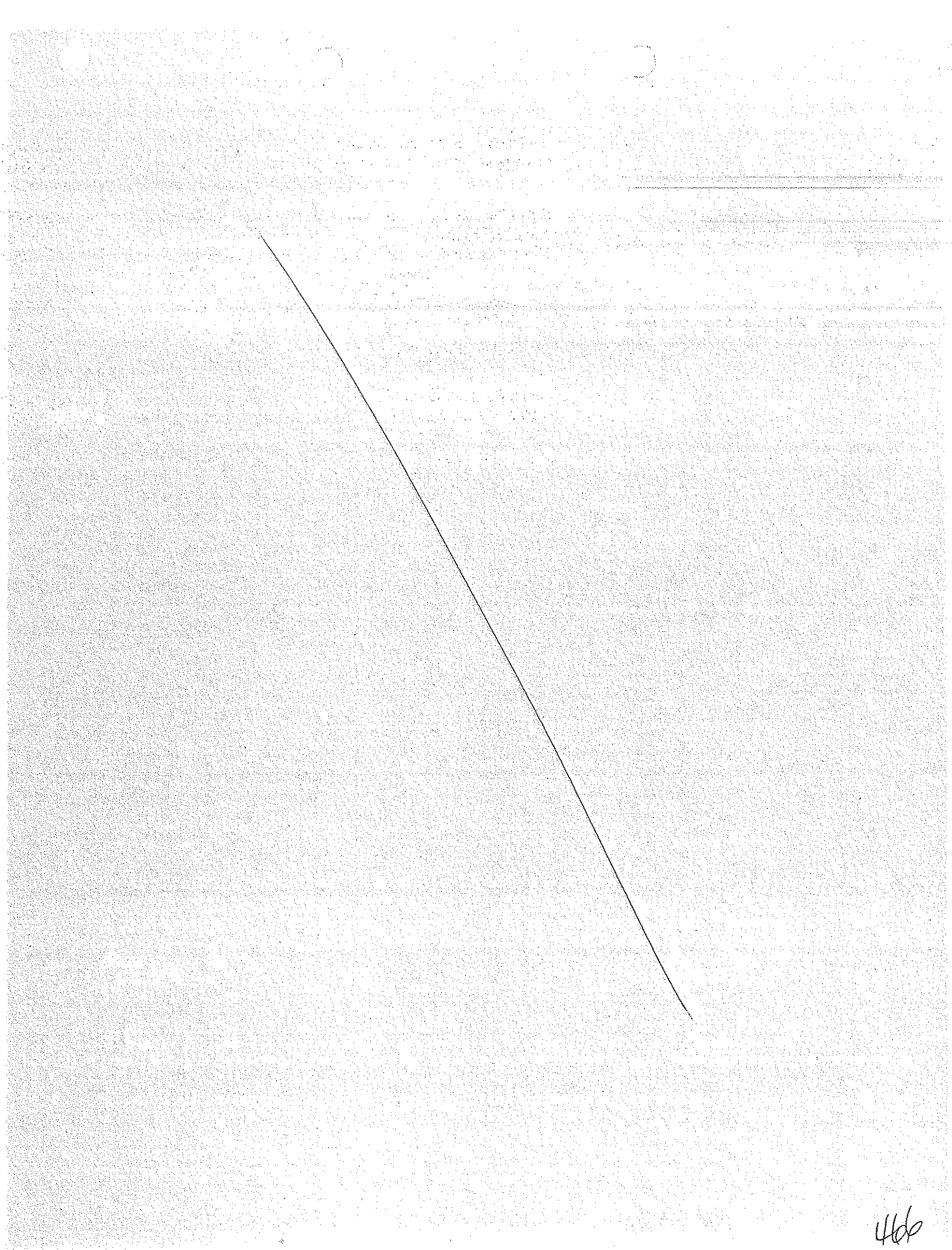
Field Records

The producer will maintain field level records for a minimum of five years. As applicable, records include:

- Soil, plant tissue, organic, and water test results as collected and recommendations for nutrient application.
- Quantities, analyses and sources of nutrients applied.
- Approximate dates and methods nutrients were applied.
- Crops planted, planting and harvest dates, yields, and crop residues removed.
- Dates of annual review and person performing the review and recommendations that resulted from the review.
- Any additional information as required by this standard, (i.e., Site Vulnerability, Site Risk Assessment, Biosolids application records, and other appropriate cautions and discussions).
- Suggested Additional Records as applicable:

  Irrigation Water Management evaluations.

  Recommended conservation practices and management actions that can reduce the potential for nutrient movement.



RISK ASSESSMENT

Determining Probability For
Off Site Transport of Soil &
Nutrients

How Important Is The Assessment?

- Basis - Core - Essence of OnePlan
  - Cumulative affects of planned practices
    - Are their off site impacts?
    - Are potential impacts Severe or Very Low
    - Recommends additional practices needed to reduce off site impacts
    - Mitigation

Data Input in OnePlan

- The assessment is transparent.
  - Data input throughout the program is used in the assessment.
  - Output is included in the report.
- Data input should reflect the "Planned Scenario"

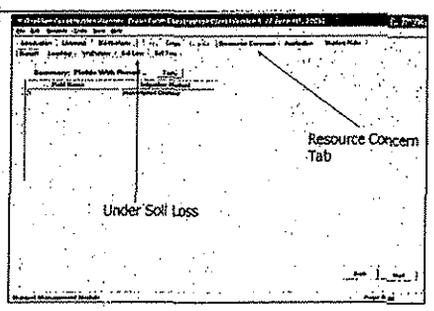
Tools Used in The Risk Analysis

- Revised Universal Soil Loss Equation (RUSLE2)
  - RUSLE2 IS TURNED OFF
  - User generates erosion rate outside of OnePlan and inputs.
- Surface Irrigation Soil Loss Model (SISL)
- Phosphorus Transport Risk Assessment

References

- RUSLE2: Idaho Technical Guide Notice 229, Released 1/6/05
- SISL: Agronomy Technical Note 32 (Rev. 3), 7/31/03
- P & N Transport Risk Assessment: Water Quality Technical Notes 1 & 2. To be released.

Location in OnePlan



468

This Session

- Will review RUSLE2
- Review / short exercise on SISL
- Exercise on the Phosphorus Transport Risk Analysis

Additional Training?

- Not intended that this session teach you how to use these tools.
- Additional Training required
  - Agency staff - request training if needed
  - Consultants - Get help from NRCS

The Water Erosion Process

Kinds of Water Erosion In Idaho (Ag Related)

- Irrigation Induced:
  - Furrow
  - Sprinkler
- Snow Melt and Rainfall
  - Sheet & Rill

Where Do They Occur?

- Irrigated Cropland:
  - Irrigation induced erosion

  And
  - Sheet & Rill
- Non Irrigated Cropland
  - Sheet & Rill

470

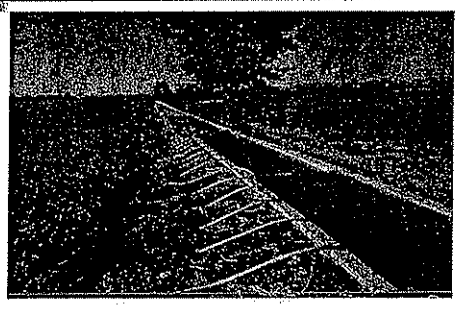
Erosion Processes The Same

- Detachment
- Transport
- Deposition

Point of Detachment –

- Sheet & Rill, & Sprinkler

Point of Detachment - Furrow



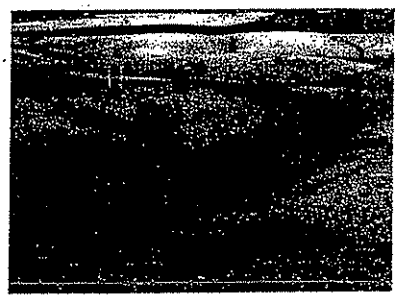
Detachment

- Separation of soil particles from soil surface
  - Particles suspended in water

Effects of Detachment

- Soil Erosion
- Loss of top soil
- Sustainability:
  - Soils long term capability to produce crops

Sustainable ?

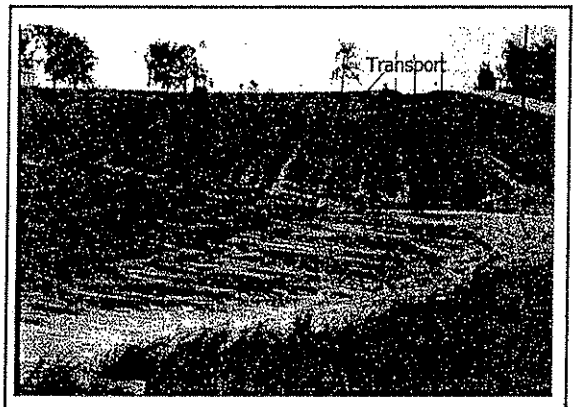


472

Sustainable ?

Transport

- Movement of suspended soil in the water stream



473

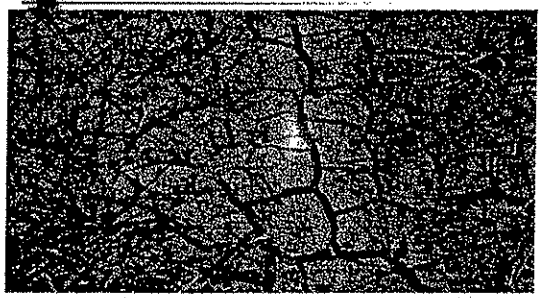
Transport

- Need slide on furrow

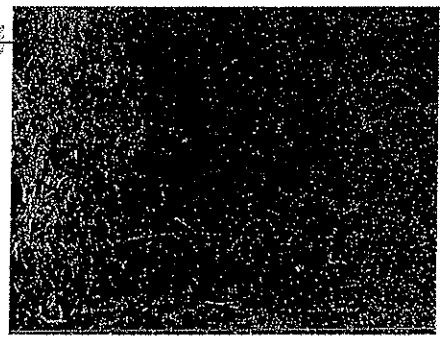
Deposition (Sedimentation)

- Soil particles settle out of the transport medium (water)
- Impacts:
  - On site
  - Off Site

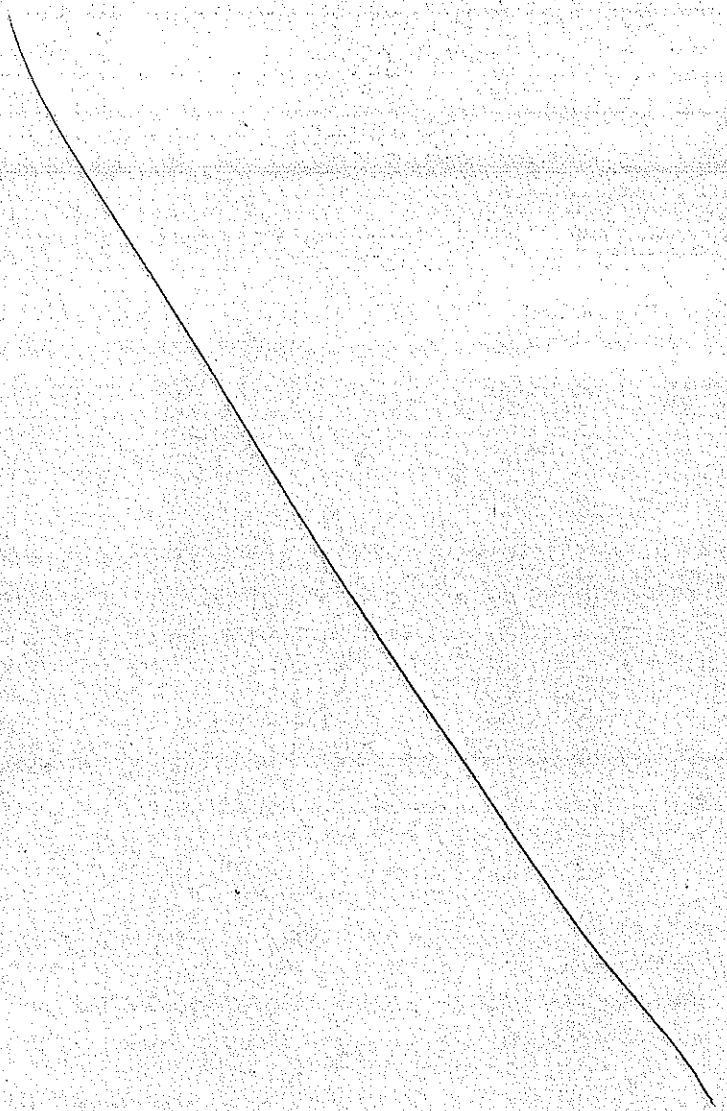
Effects On Site



Off Site



- Effects Off Site



Predicting Soil Erosion By Water:
A Guide to Conservation Planning

REVISED UNIVERSAL SOIL LOSS EQUATION

OBJECTIVES

- Review RUSLE2 factors and use
- Discuss RUSLE2 applications
- Request training in needed

Where Does It Apply ?

- Principle Use:
  - Cropland where soil erosion occurs caused by:
    - Snow melt
    - Rainfall
  - Termed: Sheet & Rill Erosion

Other Uses

- Disturbed forest land – roads, logging decks
- Construction sites
- Surface mine reclamation
- Landfill reclamation
- Pasture / hay in rotation

Where did It Come From?

- Agricultural Research Service (ARS)
  - Zingg's equation (1940)
  - Smith and Whit's equation (1947)
  - AH-282 (1965)
  - *"Disturbed land"* (1975)
  - AH-537 (1978)
  - RUSLE (1992)

Program Development

- Joint effort between NRCS and ARS
- Programmer: ARS/Contractor
- Current Version:
  - 1.18 Aug 2004
  - Windows Based

ARS

- Conducted field research to:
  - Determine effects of tillage equipment on soil condition and structure
  - Effects of tillage on crop residue (biomass)
  - *Vegetative grow curves (biomass)* data for crops

NRCS Contribution

- NASIS Soil Data
- Climatic Data
  - 30 year weather station

Where Is Sheet & Rill Erosion A Problem?

- Steep Slopes
- High precipitation
- Conventional / inversion tillage
- Intensive tillage
- Rotations with low % high residue crops

County That Looks Like This.

Not County That Looks Like This.

How Is It Used

- Planning Tool
- Compare the current system to a planned system
  - Evaluate alternative systems

Output

- Average annual soil erosion
- Sediment delivered off site
- Soil Condition Index
- Reports:
  - Saved / printed in Word

Average Annual Soil Erosion

- Annual soil erosion rate for each crop averaged for the rotation
- Sediment: Within the field & off site

Soil Condition Index

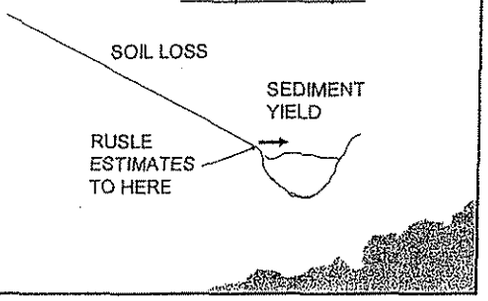
- Determines the overall impact of the crop rotation and tillage system on soil condition and organic matter
  - Index: $\geq$ 0 is good

What Do You Remember?

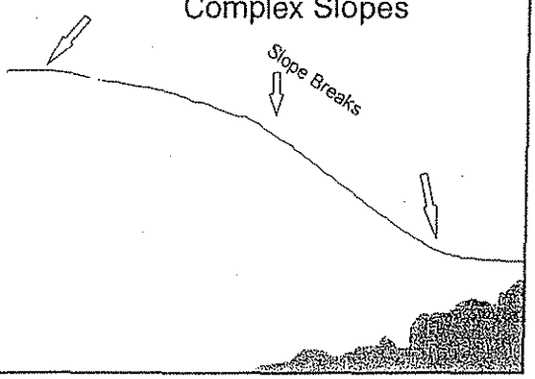
- There are 3 basic components of the erosion process. What are they?

What RUSLE Estimates

Simple Slope



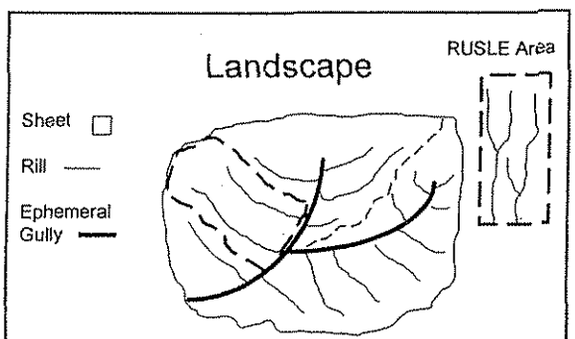
Complex Slopes



Which To Use?

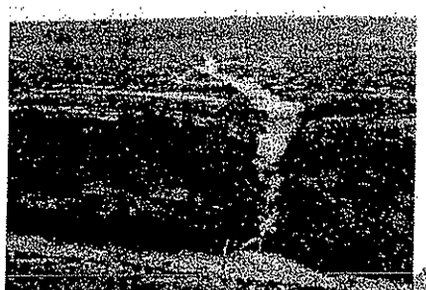
- Simple Slope: Represents the typical situation in the field.
- Complex Slope: Defines a specific "line of sight" within the field

Landscape



Erosion Types

Ephemeral Gully Erosion NOT Estimated by RUSLE2



RUSLE FACTORS

A = RKLSCP

A = AVERAGE ANNUAL SOIL LOSS (TONS/ACRE/YEAR)

Factors:

R - Rainfall/Runoff
K - Soil Erodibility
L - Slope Length
S - Slope Steepness
C - Cover-Management
P - Support Practices

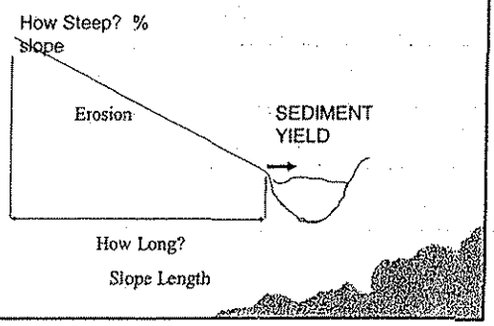
R Factor

- Average annual summation of climatic values (EI)
  - E - storm energy
  - I - intensity
- From weather station data
- PNW has been adjusted to account for snow melt/rain on frozen / thawing soils

SOIL ERODIBILITY - K

- Measure of soil erodibility under standard unit plot condition
- Major factors
  - texture
  - organic matter
  - structure
  - permeability

Slope Length & % Slope



Cover - Management - C

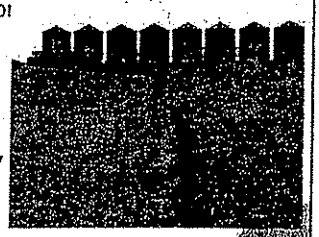
- Considers:
  - Crop rotation
  - Tillage scenarios
- Controlled by Management

Main effects of C

- Canopy (cover not touching ground)
- Ground cover (crop residue &/or cover touching ground)

Effects of C

- Surface roughness (during the erosion period)
- Within soil effect (incorporated biomass, roots, biological activity, consolidation)



Sensitivity To Tillage

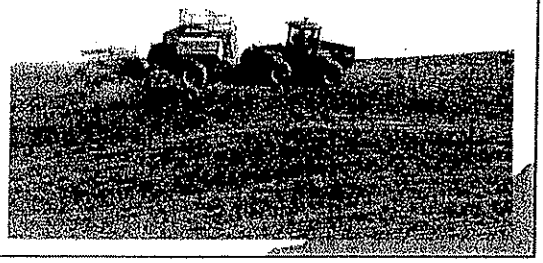
- Greatest impact:
  - Inversion tillage: plows, disks
- Moderate Impact:
  - Chisels, field cultivators
- Minimal impact:
  - Rod weeders, harrows, row cultivators

Support Practices - P

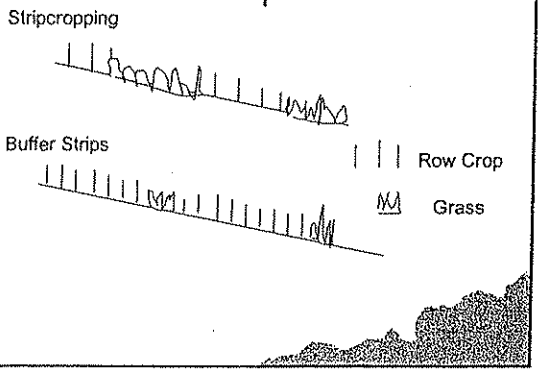
- Main Effects
  - runoff redirection
  - runoff reduction
  - local deposition
  - Shorten length of runs

Typical Support Practices

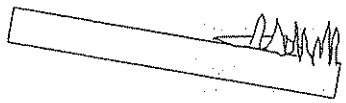
- Contour / Cross-slope farming
- Strip cropping
- Buffer strips
- Terraces/diversions



Strips



Deposition In a Grass Strip



APPLICABLE PROCESSES

- YES: Sheet and Rill Erosion
- MAYBE: Sediment Yield
- NO: Gully Erosion
- NO: Stream Channel
- NO: Mass Wasting

APPLICABLE SOILS

- Best: Medium Texture
- Moderately Well: Fine Texture
- Acceptable: Coarse Texture
- No: Organic

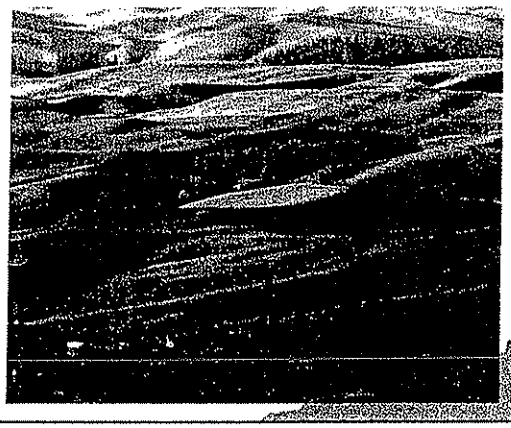
CERTAINTY

Confidence in Result

- Most: 4 < A < 30 t/ac/yr
- Moderate: 1 < A < 4
  30 < A < 50
- Least: A < 1
  A > 50

TEMPORAL APPLICABILITY

- Best: Average annual, Average season
- No: Single Storm



USDA NRCS Natural Resources Conservation Service

OnePlan Example

RUSLE2 Profile Erosion Calculation Record

Info: OnePlan example: Before situation was surface irrigated winter wheat-potato, conventional tillage. After situation, producer converted to spring wheat-potato, mulch tillage

Explanation of the Planned scenario

File: profiles\Sprinkler Irr GD\Sprinkler Irr 5, Alt 1, GD
Access Group: R2_NRCS_Sta_Agron

Inputs:
Location: Idaho\TwinFalls County\ID_Twin_Falls_Req_10
Soil: 10 BAHEM SILT LOAM, 1 TO 4 PERCENT SLOPES\BAHEM silt loam 90%
Slope length (horiz): 600 ft
Avg. slope steepness: 0.50 %

Precipitation
Soil
Length and % Slope

Management	*Vegetation*	*Yield units*	*Yield (# of units)*
CMZ 10\b.Mullti-year Rotation Templates\CSP Sprinkler Irr. GD\Sprinkler Irr. 5: Alt 1, GD	Wheat, spring, CMZ 10, 10 in. spac.	bu	120.00
CMZ 10\b.Mullti-year Rotation Templates\CSP Sprinkler Irr. GD\Sprinkler Irr. 5: Alt 1, GD	Potato, Irish	cwt	300.00

Rotation

Contouring: a. rows up-and-down hill
ips/barriers: (none)
version/terrace, sediment basin: (none)
Subsurface drainage: (none)
Adjust res. burial level: Normal res. burial
General yield level: Set by user
Rock cover: 0 %

Other Inputs

Outputs:
Soil loss erod. portion: 0.34 t/ac/yr
Detachment on slope: 0.34 t/ac/yr
Soil loss for cons. plan: 0.34 t/ac/yr
Sediment delivery: 0.34 t/ac/yr
Net C factor: 0.079
Net K factor: 0.43

Sheet & Rill erosion rate

Crit. slope length: --
Surf. cover after planting: --

Tillage operations

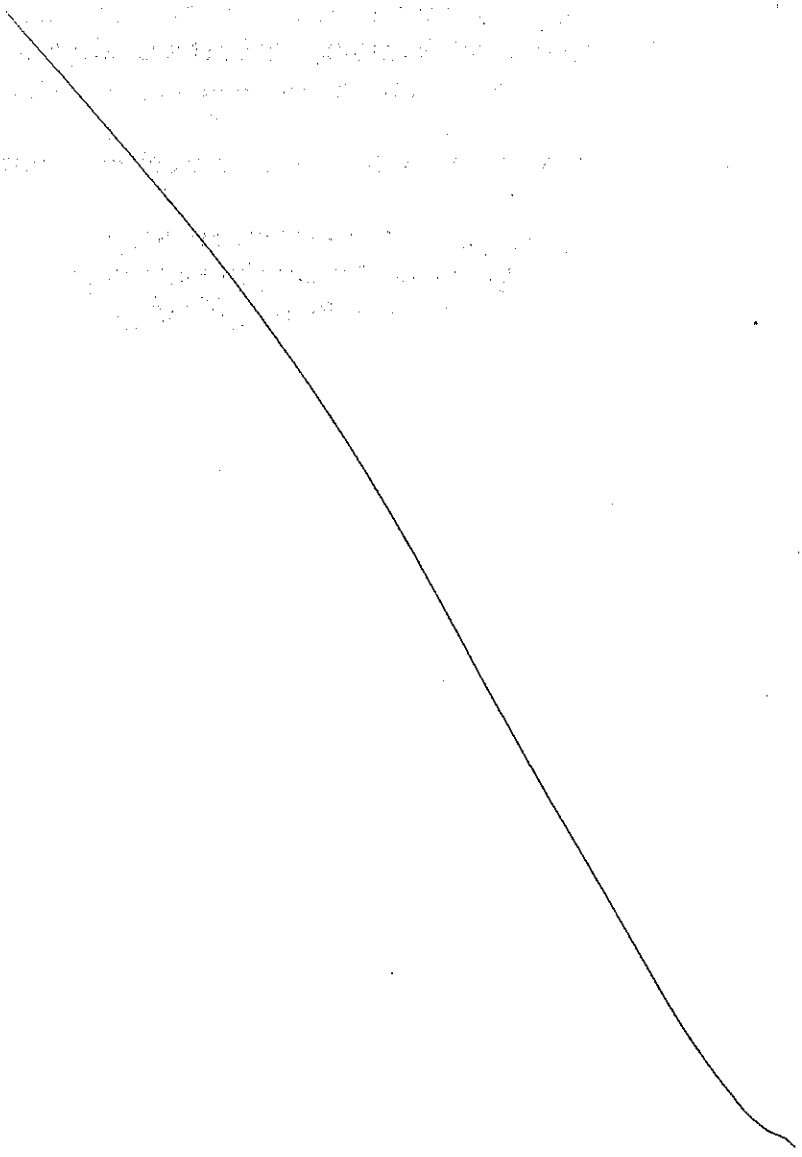
Date	*Operation*	*Vegetation*	*Surf. res. cov. after op, %*
4/20/0	Cultivator, field 6-12 in sweeps		5.7
4/21/0	Fert applic. surface broadcast		5.6
4/23/0	Harrow, spike tooth		4.3
4/25/0	Drill or airseeder, double disk	Wheat, spring, CMZ 10, 10 in. spac.	3.8
8/15/0	Harvest, killing crop 50pct standing stubble		92
5/1/1	Cultivator, field w/ spike points		58
5/10/1	Bed shaper		50
15/1	Planter, double disk opnr	Potato, Irish	51
/5/1	Cultivator, row 3 in ridge		26

9/10/1	Harvest, dig root crops res. buried		11

Soil conditioning index (SCI): 0.1
STIR value: 71.77

The SCI is the Soil Conditioning Index rating. If the calculated index is a negative value, soil organic matter levels are predicted to decline under that production system. If the index is a positive value, soil organic matter levels are predicted to increase under that system.

The STIR value is the Soil Tillage Intensity Rating. It utilizes the speed, depth, surface disturbance percent and tillage type parameters to calculate a tillage intensity rating for the system used in growing a crop or a rotation. STIR ratings tend to show the differences in the degree of soil disturbance between systems. The kind, severity and number of ground disturbing passes are evaluated for the entire cropping rotation as shown in the management description.



SURFACE IRRIGATION SOIL LOSS MODEL

SISL
Version 4
2004

Use

- Predicts average annual sediment in tons/ac generated from furrow irrigated cropland
  - Does Not predict sediment from sprinkler irrigation
- Planning Tool:
  - Evaluates current rotation and tillage scenario
  - Evaluates alternative rotation & tillage scenarios

Background

- Agricultural Research Service, Snake River Research Center
  - Version 1: Dr. David Carter
    - Original field research
    - Developed model - hardcopy
  - Version 2:
    - Excel spreadsheet
  - Version 3: July 31, 2003
    - Updated field research

Current Version

- Version 4, July 31, 2003
  - Dr. Robert Sojka
  - Dr. Rick Leitz
  - Dr. David Bjornberg

Primary Resource

- Agronomy Technical Note 32, July 31, 2003
  - Clair Prestwich, NRCS, State Irrigation Engineer
  - Ralph Fisher, NRCS, State Agronomist
  - Reference Attached Technical Note

Formula

- SISL = BSL X KA X PC X CP X IP
- Where:
  - BSL: Base Soil Loss (Table 1)
    - *Represents average soil loss before model variables are applied.*

Formula Continued

- KA: Adjusted K, (Table 2)
  - "K" Soil erodibility factor
  - "A" Adjustment by soil type erodibility
  - Standard or base soil: Portneuf silt loam
- PC: Prior Crop (Table 3)
  - Reflects the effects of prior crops – organic matter

Formula Continued

- CP: Conservation Practices (Table 4)
  - Reflects the effects of applied conservation practices
- IP: Irrigation Management Practices (Table 5)
  - Reflects the effects of applied irrigation practices

Definitions

- Crop Classes:
  - Permanent Cover: sod crops
  - Close Growing Crops: cereals, green manure peas
  - Row Crops: beans, corn
  - Intensively Managed Row Crops: sugar beets, onions

Definitions

- End of Row Condition: convex end
  - None, no convex end
  - M: Medium, < 6 inches
  - S: Severe, > 6 inches

Definitions

- Irrigation Systems:
  - Siphon tubes
  - Gated pipe
  - Earth ditch with cutouts
- Percent Slopes:
  - < 1%
  - 1.1% - 1.9%
  - 2.0% - 2.9%
  - > 3%

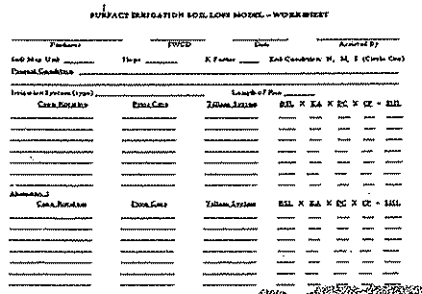
Definitions

- Lengths of run:
  - 660 feet
  - 1320 feet
- Conventional Tillage:
  - Tillage/rotation systems without conservation practices
- Residue Management:
  - Crop and tillage systems which leave residue cover during the critical erosion period

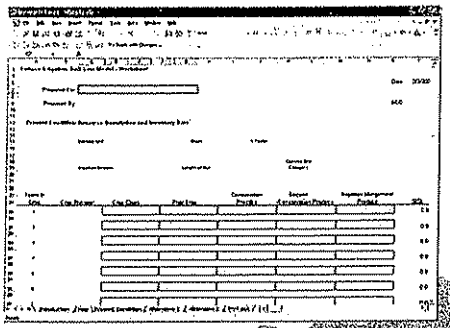
Definitions

- Polyacrylaminde (PAM)
  - Full season: applied prior to each irrigation all season long
  - Part season: applied prior to each irrigation until July 15
- PAM Support Practices:
  - Conservation practices which provide addition benefit to PAM
    - IWM, Residue Management, surge irrigation system

SISL Worksheet

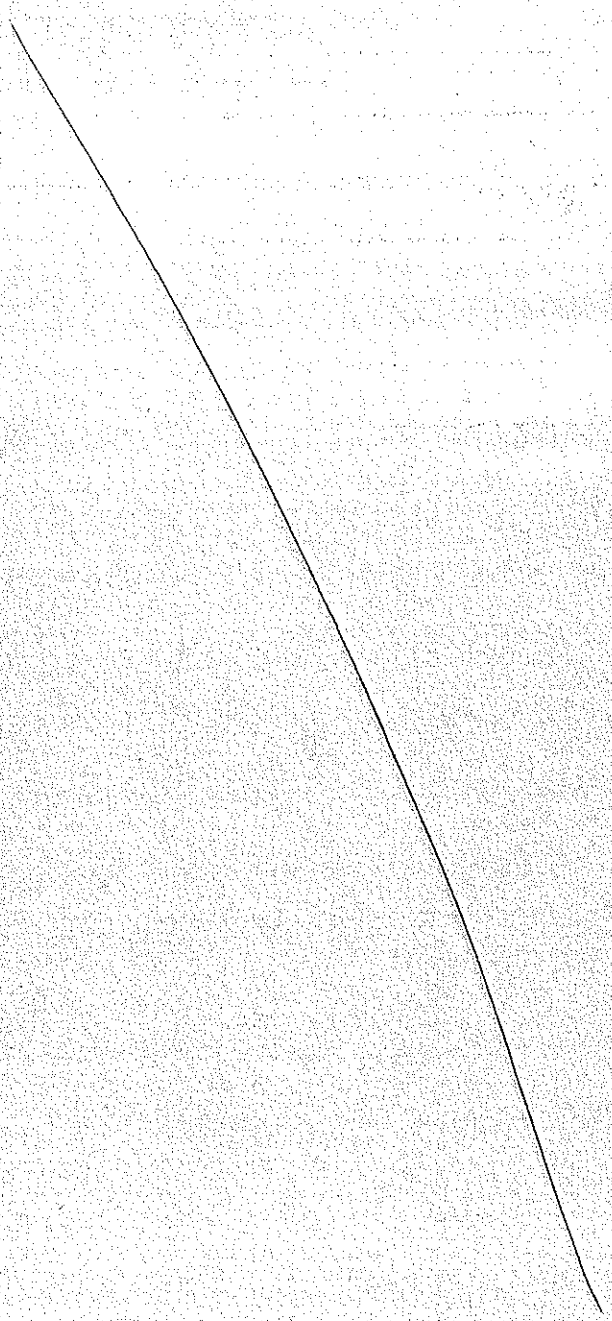


SISL Excel Spreadsheet



Exereise

- Rotation: Winter Wheat – potato
  - Wheat residue harvested
- Tillage System: Conventional
- Soil: Portenuf fine sandy loam: K = 37
- Slope: < 1%
- Length of Run: 1000 ft.
- Kind of irrigation system: siphon tubes
- Convex End: Severe



Technical Notes

USDA-Soil Conservation Service
Boise, Idaho

AGRONOMY TECH NOTE NO. 32 (Rev.3) July 31, 2003

Revised by Clare Prestwich, Irrigation Engineer, NRCS, Idaho and Ralph Fisher, State Conservation Agronomist, NRCS, Idaho in consultation with Drs. Robert Sojka, Rick Lentz, and David Bjornberg, Agricultural Research Service, Snake River Conservation Research Center, Kimberly, Idaho.

PREDICTING IRRIGATION INDUCED SOIL LOSS ON SURFACE IRRIGATION CROPLAND Using SURFACE IRRIGATIION SOIL LOSS MODEL (SISL)

Irrigation induced erosion caused by furrow irrigation has long been recognized as a serious problem on surface irrigated croplands. It causes significant on-site and off-site adverse impacts including soil erosion, sediment deposition, reduced soil quality and reduction of surface water quality resulting from sediment delivery and associated nutrient and pesticide loading. In 1991 SISL was developed in cooperation with the Agricultural Research Service at the Snake River Conservation Research Center at Kimberly, Idaho providing a research-based method for predicting soil losses from furrow irrigation induced erosion. SISL can not be used to predict soil erosion or sedimentation from sprinkler irrigation systems. The model was updated in 1994 with additional technical data provided by the Research Center and again in 2000 providing a computer model which could be used in the planning process. Original research evaluated traditional methods of reducing furrow irrigation induced erosion such as Irrigation Water Management, Residue Management, and Straw Mulching. In recent years Anionic Polyacrylamide (PAM) was introduced as an affective way to reduce irrigation induced erosion on furrow irrigated cropland. Revision 2 of the model included the affects of PAM in SISL. Research on PAM has continued at the Kimberly Center providing additional data which has been included in this Technical Note. It includes the revised computer model and hard copy worksheets for those who wish to calculate erosion/sediment rates manually.

The SISL Model is based on the formula:

SISL = BSL X KA X PC X CP X IP

Where:

SISL = Surface irrigation soil loss from a field in tons per acre per year.

BSL = Base soil loss rate average from ARS soil loss measurements on over 200 sites in the Rock Creek Clean Water Project. Use Table 1 to obtain the base erosion rate.

KA = Soil erodibility adjustment for the soil in relation to the soil on which the base erosion data was obtained. (Portneuf silt loam with K of .49.) Use Table KA to select K adjustment.

PC = Prior crop impacts on reducing soil erosion. Use PC table to select factor

representing the prior crop.

CP = Conservation practice impacts on reducing soil erosion. Use CP table to obtain the factor representing the conservation practice.

IP = Irrigation Management practice impacts on reducing soil erosion. Use IP table to obtain the factor representing the Irrigation Management practice.

Instructions for using the Surface Irrigation Soil Loss Model.

1. Identify soil, slope and K factors representing the field.
2. Identify the irrigation system, length of run and convex end category representing the field.
3. Identify the crop now growing, the prior crop and the tillage system used on the field.
4. From Table 1, select the base soil loss rate representing the irrigation system, slope, crop and convex end category.
5. Select the K adjustment value for the representative soil from Table 2.
6. Select the PC value representing the prior year's crop from Table 3.
7. Select the CP values from Table 4. When doing present condition select values for existing conservation practices on the land. When planning practice alternatives, select values for planned conservation practices. When multiple conservation practices are used, multiply the factors to obtain a single conservation practice value.
8. Select the IP values from Table 5. When doing present condition select values for existing conservation practices on the land. When planning practice alternatives, select values for planned conservation practices. When more than one conservation practices is planned, multiply the factors for each practice to obtain a single Irrigation Management practice value.
9. Multiply factors representing BSL, KA, PC, CP, and IP. The product is surface irrigation soil loss in tons per acre per year.

The SISL Model estimates soil loss (sediment yield) from off the bottom of a surface irrigated field. It does not estimate total soil movement (soil erosion) occurring on the field.

TABLE 1 – BASE SOIL LOSS

Estimated Soil Loss for Siphon Tube Irrigation Systems
with Run Lengths: 660 & 1320 Ft.

Average Field Slope		<1 %			1 - 1.9 %			2 – 2.9 %			> 3 %		
Convex End Condition		N	M	S	N	M	S	N	M	S	N	M	S
Permanent Cover	660	0	0	0	0.7	0.9	1.2	2.3	2.9	4.1	5.6	7.0	9.8
	1320	0	0	0	0.6	0.7	1.0	1.8	2.3	3.3	4.5	5.6	7.8
Close Growing	660	1.1	1.3	1.8	3.2	4.0	5.6	6.4	8.0	11.2	10.4	13.0	18.2
	1320	0.9	1.0	1.4	2.6	3.2	4.5	5.1	6.4	9.0	8.3	10.4	14.6
Row Crop	660	2.5	3.1	4.4	8.7	10.9	15.3	18.4	23.0	32.2	28.0	35.0	49.0
	1320	2.0	2.5	3.5	7.0	8.7	12.2	14.7	18.4	25.8	22.4	28.0	39.2
Intensive Row	660	3.2	4.0	5.6	12.1	15.2	21.2	26.4	33.0	46.2	44.0	55.0	77.0
Crop	1320	2.6	3.2	4.5	9.7	12.2	17.0	21.1	26.4	37.0	35.2	44.0	61.0

Estimated Soil Loss for Gated Pipe Irrigation Systems
with Run Lengths: 660 & 1320 Ft.

Average Field Slope		<1 %			1 - 1.9 %			2 – 2.9 %			> 3 %		
Convex End Condition		N	M	S	N	M	S	N	M	S	N	M	S
Permanent Cover	660	0	0	0	0.7	0.9	1.3	2.4	3.0	4.3	5.9	7.4	10.3
	1320	0	0	0	0.6	0.7	1.0	1.9	2.4	3.4	4.7	5.9	8.2
Close Growing	660	1.2	1.4	1.9	3.4	4.2	5.9	6.7	8.4	11.8	10.9	13.7	19.1
	1320	1.0	1.1	1.5	2.7	3.4	4.7	5.4	6.7	9.4	8.7	11.0	15.3
Row Crop	660	2.6	3.3	4.6	9.1	11.4	16.1	19.3	24.2	32.2	29.4	36.8	51.5
	1320	2.1	2.6	3.7	7.3	9.1	12.9	15.4	19.4	25.8	23.5	29.4	41.2
Intensive Row	660	3.4	4.2	5.9	12.7	16.0	22.3	27.7	34.7	48.5	46.2	57.8	80.9
Crop	1320	2.7	3.4	4.7	10.2	12.8	17.8	22.2	27.8	38.8	37.0	46.2	64.7

Estimated Soil Loss for Dirt Ditch Irrigation Systems with Feeder Ditch
with Run Lengths: 660 & 1320 Ft.

Average Field Slope		<1 %			1 - 1.9 %			2 – 2.9 %			> 3 %		
Convex End Condition		N	M	S	N	M	S	N	M	S	N	M	S
Permanent Cover	660	0	0	0	0.8	1.0	1.4	2.6	3.3	4.7	6.4	8.1	11.3
	1320	0	0	0	0.6	0.8	1.1	2.1	2.6	3.4	5.1	6.5	9.0
Close Growing	660	1.3	1.5	2.1	3.7	4.6	6.4	7.4	9.2	12.9	12.0	15.0	20.9
	1320	1.0	1.2	1.7	3.0	3.7	5.1	5.9	7.4	10.3	9.6	12.0	16.7
Row Crop	660	2.9	3.6	5.1	10.0	12.5	17.6	21.2	26.5	32.2	32.2	40.3	56.4
	1320	2.3	2.9	4.1	8.0	10.0	14.1	17.0	21.2	25.8	25.8	32.2	45.1
Intensive Row	660	3.7	4.6	6.4	13.9	17.5	24.4	30.4	38.0	53.1	50.6	63.3	88.6
Crop	1320	3.0	3.7	5.1	11.1	14.0	19.5	24.3	30.4	42.5	40.5	50.6	70.9

Definitions:

Crop Classes: Refers to the kind and general level of management related to production of a particular crop.

Permanent Cover:	Alfalfa, pasture, grass, etc.
Close Growing Crop:	Grain, peas, etc.
Row Crops:	Beans, Corn, etc.
Intensively Managed Row Crops:	Sugar Beets, Onions, Potatoes

End of Field Condition: Refers to the shape of the field at point sediment leaves the field. Some fields slope slightly into a tailwater recovery ditch while others drop off steeply. The steeper the drop the greater the sediment delivery rate from the end of the field.

N = *None. There is no difference in elevation from the end of the field grade to the bottom of the* recovery ditch.
M = Medium. Less than a 6 inch drop from field level grade to the tailwater recovery ditch.
S = Severe. Greater than a 6 inch drop from field level grade to the tailwater recovery ditch.

Irrigation System: The model evaluates three types of irrigation systems commonly used in furrow irrigation systems; Siphon Tube, Gated Pipe, and Earth Ditches with Feeder Ditches.

Per cent slope: the model evaluates 4 slope breaks, <1%, 1 – 1.9%, 2 – 2.9%, >3%.

Lengths of Run: The model evaluates two lengths of run, 660 feet and 1320 feet.

Base Soil Loss, Table 1: The variables defined above are combined in a matrix (Table 1), providing a "base soil loss" which represents an average soil loss before other factors are introduced into the model.

Table 4. Conservation Practices

Conventional Tillage: Conventional systems are represented by intensive tillage systems which may include inversion and non-inversion tillage implements.

Residue Management Practices including Seasonal, Mulch Till and No Till. These systems represent a higher level of residue management by a reduced number and intensity of tillage operations. As a result more residue is maintained on the soil surface through the critical erosion period.

Polyacrylaminde (PAM). Includes the application of this product as per the NRCS practice standard for the purpose of reducing soil erosion and increasing water infiltration in the irrigation furrow. PAM can be applied "full season" or "part season to furrows. "Full Season" application is defined as application of the product prior to every irrigation including pre-irrigation through the irrigation season. "Part Season" is defined as application of the product prior to every irrigation including pre-irrigation until July 15th.

PAM Support Practices. PAM can be applied by itself or with support practices. Support practices further reduce soil movement off the field and have a direct impact on movement of irrigation water in the furrow. Support practices include improved surface irrigation systems (surge), irrigation water management and residue management practices. Adjustment factors are provided for:

PAM by itself
PAM + Irrigation Water Management
PAM + Irrigation Water Management + Residue Management.
PAM + Surge Irrigation System

Deep Tillage: The NRCS practice standard Chiseling and Subsoiling has been renamed as Deep Tillage. This practice includes operations formally referred to as chiseling and subsoiling.

Note: Previous versions of SISL double accounted for the effect of PAM. Sediment rates provided by ARS reflected the combined effects of PAM + IWM. Users were instructed to add support practices including IWM planned by the producer to reflect the cumulative affects of a system. As a result planned sediment rates were lower than they should have been.

TABLE 2
Soil Erodibility – KA

Soil K	Adjustment
0.22	0.45
0.28	0.57
0.32	0.65
0.37	0.76
0.43	0.87
0.49	1.00
0.55	1.12

Conservation Practices – CP

Conservation Practices	Adjustment
Conventional Tillage	1.00
Residue Management - Seasonal	0.20
Residue Management- Mulch Till	0.15
Residue Management – No-Till	0.10
Polyacrylamide - Full Season	
PAM alone	0.30
PAM + IWM	0.05
PAM + IWM + Res.Mgt.	0.01
Polyacrylamide - Part Season	
PAM alone	0.50
PAM + IWM	0.20
PAM + IWM + Res.Mgt.	0.05
Deep Tillage	0.50
Alfalfa Hay – Rotational	0.20
Alfalfa Seed/Mint	0.35

TABLE 3
Prior Crop – PC

Prior Crop	Adjustment
Pasture	0.65
Alfalfa	0.70
Mint	0.70
Alfalfa Seed	0.75
Small Grain-High Residue	0.75
Small Grain- Residue Harvested	0.85
Corn-High Residue	0.75
Peas	0.80
Corn Silage	0.85
Sugar Beets	1.00
Beans	1.00
Potatoes	1.00
Onions	1.00

TABLE 5
Irrigation Management Practices – IP

Irrigation Practice	Adjustment
Irrigation Management – High Level –W/O Cutbacks	0.90
Irrigation Management – High Level – With Cutbacks	0.70
Surge Irrigation System	0.50

Remember, if calculations are done by hand, multiply IP factors together for a overall, adjusted IP factor.

TABLE 4

SURFACE IRRIGATION SOIL LOSS MODEL – WORKSHEET

Producer	SWCD	Date	Assisted By

Soil Map Unit _____ Slope _____ K Factor _____ End Condition: N, M, S (Circle One)

Present Condition: _____

Irrigation System (type) _____ Length of Run _____

Crop Rotation	Prior Crop	Tillage System	BSL X KA X PC X CP = SISL

Alternative 1

Crop Rotation	Prior Crop	Tillage System	BSL X KA X PC X CP = SISL

Alternative 2

Crop Rotation	Prior Crop	Tillage System	BSL X KA X PC X CP = SISL

Alternative 3

Crop Rotation	Prior Crop	Tillage System	BSL	X	KA	X	PC	X	CP	=	SISL

Alternative 4

Crop Rotation	Prior Crop	Tillage System	BSL	X	KA	X	PC	X	CP	=	SISL

Surface Irrigation Soil Loss Model - Worksheet

Prepared for: _____ **Date** 7/29/2003

repared by _____ **SCD**

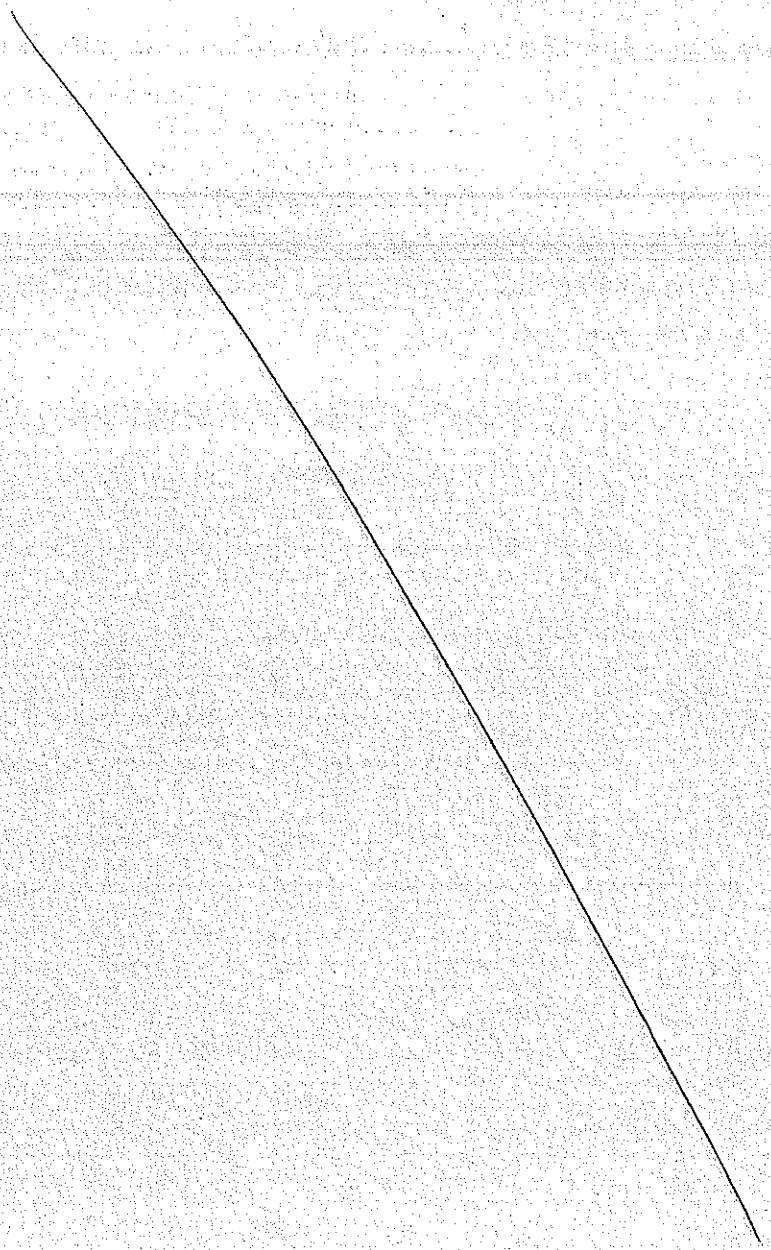
Soil Map Unit _____ **Slope** _____ **K factor** _____

Present Condition

Irrigation System_____ Length of Run_____feet Convex End Category_____

Crop Rotation	Crop Class	Prior Crop	Conservation Practice	Second Conservation Practice	Irrigation Management Practice	Second Irrigation Practi

Factors	BSL	PC	CP	IP	SISL	Total Loss (tons)	Average loss (tons/year)
	0.00	1	1	1	0.00	0.00	0.00
	0.00	1	1	1	0.00		
	0.00	1	1	1	0.00		
	0.00	1	1	1	0.00		
	0.00	1	1	1	0.00		
	0.00	1	1	1	0.00		
	0.00	1	1	1	0.00		
	0.00	1	1	1	0.00		
	0.00	1	1	1	0.00		
	0.00	1	1	1	0.00		



SISL – EXERCISE

Data Input:

- Rotation: winter wheat – potato
- Length of run: 1000 ft
- Kind of irrigation system: siphon tubes
- Soil Map Unit: 48
    - K Factor: 37
- Slope: < 1%
- End of Furrow Condition: Concave: Severe
- Current Tillage System: Conventional

What is the average annual erosion rate for the rotation?
Which crop has the highest erosion rate?
What kind of practices would help reduce irrigation induced erosion rate?

SURFACE IRRIGATION SOIL LOSS MODEL – WORKSHEET

Producer	SWCD	Date	Assisted By

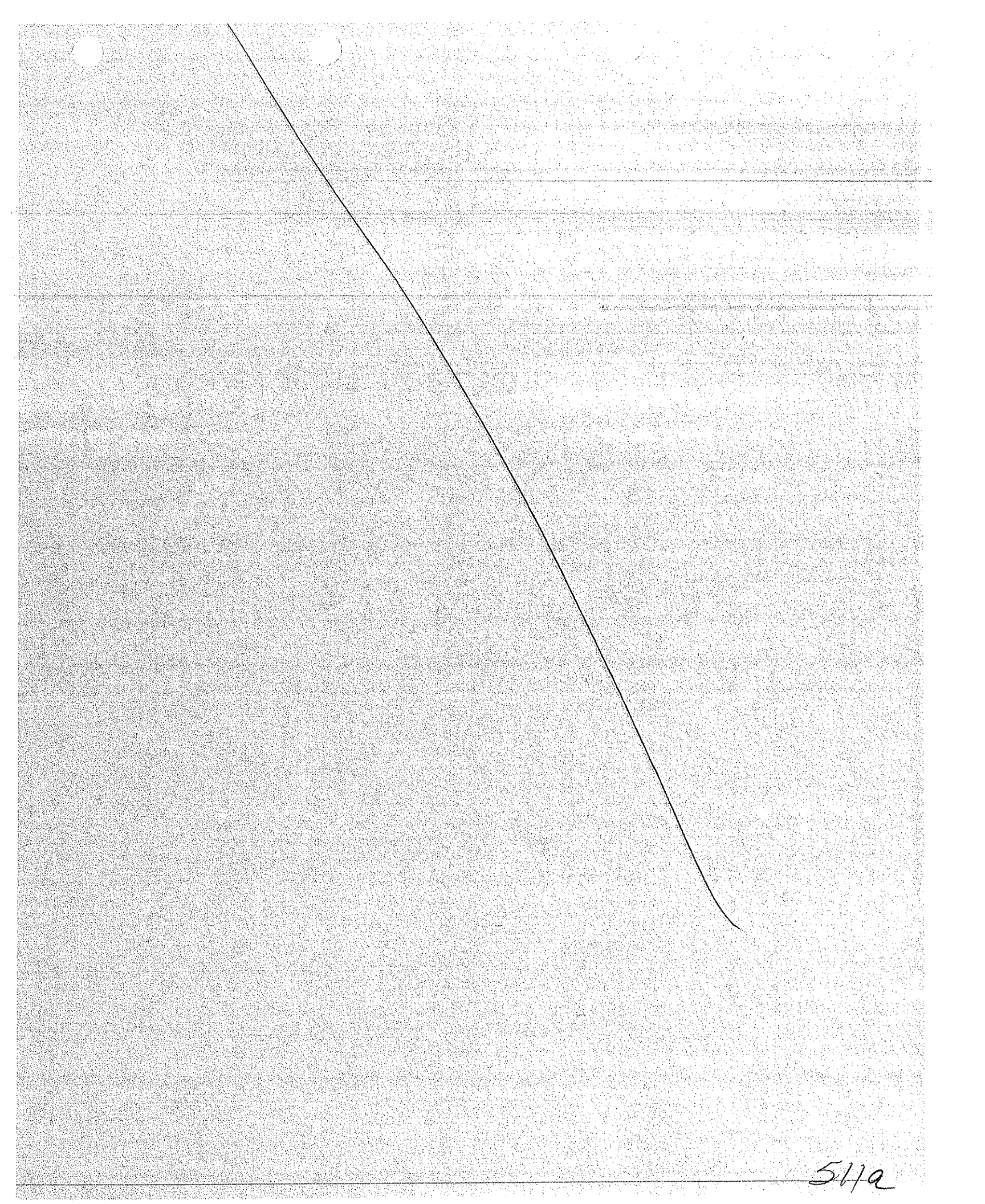
Soil Map Unit _____ Slope _____ K Factor _____ End Condition: N, M, S (Circle One)

Present Condition: _____

_____

Irrigation System (type) _____ Length of Run _____

Crop Rotation	Prior Crop	Tillage System	BSL	X	KA	X	PC	X	CP	=	SISL



The Water Erosion Process

Kinds of Water Erosion In Idaho (Ag Related)

- Irrigation Induced:
  - Furrow
  - Sprinkler
- Snow Melt and Rainfall
  - Sheet & Rill

Where Do They Occur?

- Irrigated Cropland:
  - Irrigation induced erosion

  And
  - Sheet & Rill
    - Site specific
- Non Irrigated Cropland
  - Sheet & Rill

512

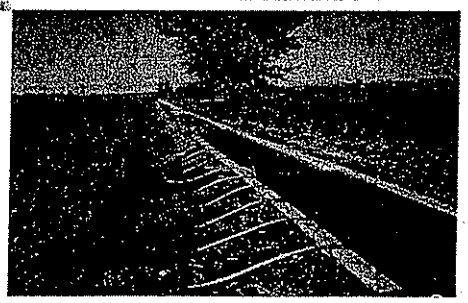
Erosion Processes The Same

- Detachment
- Transport
- Deposition

Point of Detachment –

- Sheet & Rill, & Sprinkler

Point of Detachment - Furrow



513

Detachment

- Separation of soil particles from soil surface
  - Particles suspended in water

Effects of Detachment

- Soil Erosion
- Loss of top soil
- Sustainability:
  - Soils long term capability to produce crops

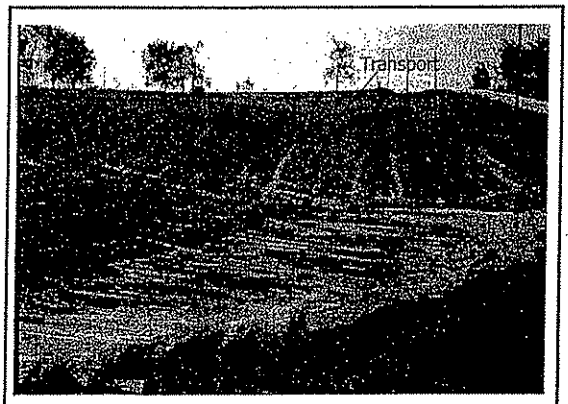
Sustainable ?

514

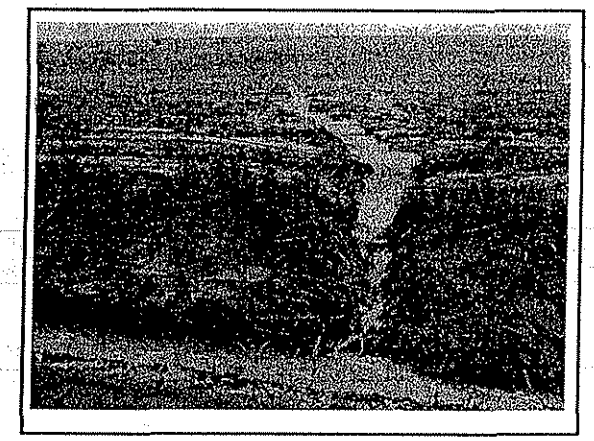
Sustainable ?

Transport

- Movement of suspended soil in the water stream

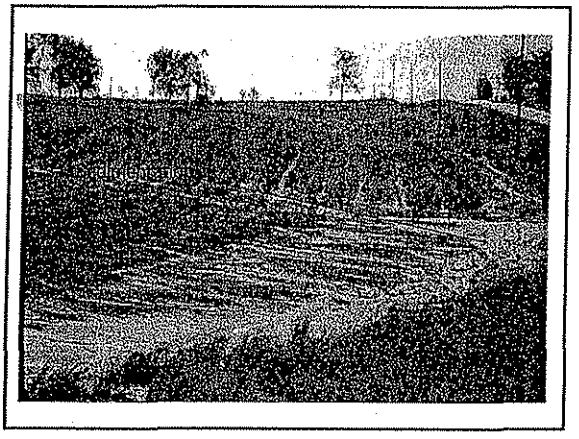


515



Deposition (Sedimentation)

- Soil particles settle out of the transport medium (water)
- Impacts:
  - On site
  - Off Site

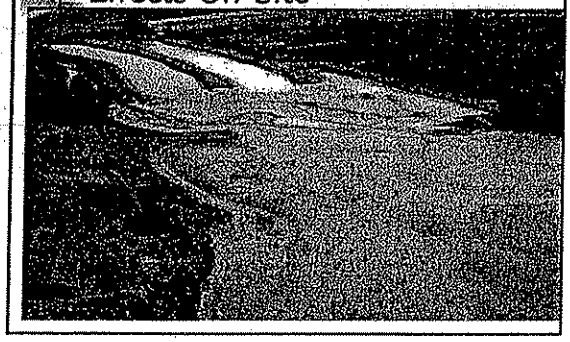


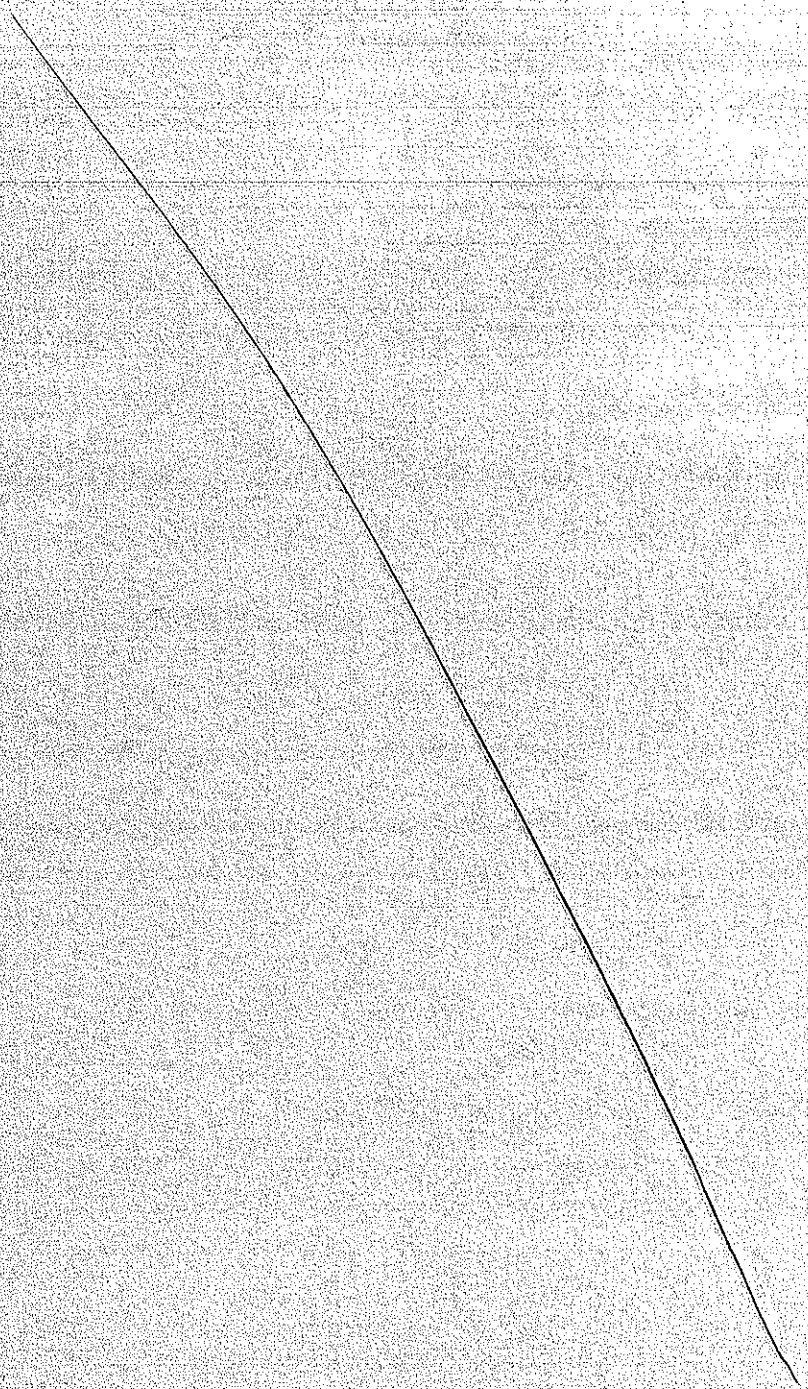
5/6

Effects On Site

Off Site

Effects Off Site





TECHNICAL NOTES

USDA-Natural Resources Conservation Service

Boise, Idaho

TN - Water Quality No. 5 *August 2005*

PHOSPHORUS TRANSPORT RISK ASSESSMENT:
A Phosphorus Assessment Tool

This Phosphorus Transport Risk Assessment is a 9 x 6 matrix that uses a limited number of landform site and management characteristics to determine the probability of off-site transport of phosphorus. The assessment can be used as a stand-alone site evaluation or as part of an overall planning process imbedded within the ONEPLAN Nutrient Management Planner program. The assessment, together with a nutrient management plan, is used as a tool for understanding the contribution that individual landform and management parameters have on phosphorus transport, and the potential for applied conservation practices (Best Management Practices) to mitigate situations where transport can occur.

Phosphorus Concerns in the Environment

Eutrophication can be caused by the nutrient enrichment of a water body. Nutrient movement in runoff and erosion from agricultural non-point sources is a resource management concern. The movement of phosphorus (P) in runoff from agricultural land to surface water can accelerate eutrophication. Undesirable aquatic plant growth results from additions of phosphorus to the water. The net result of the eutrophic condition and excess plant growth is the depletion of oxygen in the water due to the heavy oxygen demand by microorganisms as they decompose organic material. Past control efforts have focused on identification and control of point source inputs of P to surface waters. Recent emphasis has shifted to management strategies to minimize the non-point movement of P in the landscape. Phosphorus is generally the limiting nutrient in fresh water systems and any increase in P usually results in more aquatic vegetation. Although there are no direct human health impacts from eutrophication of surface waters, society is concerned about maintaining clean water, especially for drinking water purposes. This concern now includes a cost for removing the color, taste and odor associated with the high trophic condition and vegetation growth in surface water due to excess nutrients.

Phosphorus Movement Factors

The main factors influencing P movement can be separated into the transport, phosphorus source and phosphorus management factors. Transport factors include the mechanism by which P moves within the landscape. These are rainfall, irrigation, erosion and runoff. Factors which influence the source and amount of P available to be transported are soil P content and form of P applied. Phosphorus management factors include the method of application, timing and placement in the landscape as influenced by the management of application equipment and tillage.

520

Phosphorus Movement in the Landscape

Phosphorus movement in runoff occurs as particulate P and dissolved P. Particulate P is attached to mineral and organic sediment as it moves with the runoff. Dissolved P is in the water solution. In general, particulate P is the major portion (75-90%) of the P transported in runoff from cultivated land. Dissolved P makes up a larger portion of the total P in runoff from non-cultivated lands such as pastures and fields with reduced tillage. In terms of its impact on eutrophication of water bodies, particulate P becomes less available to algae and plant uptake than dissolved P because of the chemical form it has with the mineral (particularly iron, manganese, aluminum, or calcium amorphous oxides and silicates) and organic compounds. The availability of particulate P to plants and algae is variable, ranging from 10 - 90% of the total P, yet can represent a long-term source of P for algae and plant uptake from the water body. Dissolved P is 100% bioavailable to plants. Added together, the bioavailable portion of particulate P and the dissolved P represent the phosphorus that promotes eutrophication of surface waters.

The method by which P in both particulate and dissolved form moves within the landscape is simplified in the following description. Eroding soil material is transported by runoff. During detachment and movement of sediment in runoff, the finer clay-sized fraction of the source material is preferentially eroded. The P content and reactivity of the eroded material to P are usually greater than the source soil from which it was eroded. The suspended sediment in the runoff can rapidly adsorb the dissolved P in the runoff water.

As runoff moves from the landscape toward the water body, there is generally a progressive dilution of P through additions of water and a reduction in the amount of sediment carried due to sediment deposition. Phosphorus may become more bioavailable by the sorption and desorption processes, and by the preferential transport of clay-sized material as sediment moves over the landscape.

The movement of dissolved P begins with desorption, dissolution, and extraction of P from the soil, plant and organic material. These processes occur when rain and runoff water interact with the thin layer of surface soil (0.05 - 0.10 inches). Some water infiltrates into the soil and percolates through the profile where desorption of P will result in a low dissolved concentration in subsurface and return flow. High dissolved P concentration can be expected in the water percolating through organic, coarse-textured, and oxygen depleted (reduced), water-logged soils. Soil pH also affects the movement and availability of phosphorus.

The interaction between the particulate and dissolved P in the runoff is very dynamic and the mechanism of transport is complex. Therefore, it is difficult to predict the transformation and ultimate fate of P as it moves through the landscape.

The Concept

The purpose of the Phosphorus Transport Risk Assessment is to provide field staffs, watershed planners and land users with a tool to assess the various landforms and management practices for potential risk of phosphorus movement to water bodies. The assessment ranking identifies sites where the risk of phosphorus movement may be relatively higher than that of other sites. When

the parameters of the assessment are analyzed, it will become apparent that an individual parameter or parameters may be influencing the assessment disproportionately. These identified parameters can be the basis for planning corrective soil and water conservation practices and management techniques. If successful in reducing the movement of phosphorus, the concern of phosphorus enrichment will also be reduced.

A number of soil, hydrology and land management site characteristics will describe the landform. The Phosphorus Transport Risk Assessment (Table 1) is a simple 9 by 6 matrix utilizing parameters that can have an influence on phosphorus availability, retention, management and movement. These nine site characteristics are:

- Soil test P (available phosphorus in soil laboratory test units relative to the *Phosphorus Threshold* per Idaho Nutrient Management Practice Standard 590)
- P fertilizer application rates (in pounds available phosphate per acre)
- P fertilizer application methods
- Organic P source application rates (in pounds available phosphates per acre)
- Organic P source application methods
- Runoff index/runoff class
- Runoff conservation practices
- Sheet and rill or irrigation-induced soil erosion (in tons per acre per year)
- Distance to the nearest receiving water body

Field specific data for the nine site characteristics selected for this version (Table 1) of the Phosphorus Transport Risk Assessment are readily available at the field level. Some analytical testing of the soil and organic material is required to determine the rating levels. This soil and material analysis is considered essential as a basis for the assessment.

The nine site characteristics (described below) used in the assessment are rated as VERY LOW/NOT APPLICABLE, LOW, MEDIUM, HIGH, or VERY HIGH (and some use CRITICAL) by determining the range for each category. The sum of the site characteristic rankings provides an index of the potential for off-site phosphorus transport (Table 2).The following describes how the assessment functions within ONEPLAN, but the descriptions and rating categories also apply to the worksheet and spreadsheet formats as well.

Soil P Test

A soil sample from the site is necessary to assess the relative level of "plant available P" in the surface layer of the soil. The plant available P is the level customarily given in a soil test analysis by the Cooperative Extension Service or commercial soil test laboratories. The Assessment uses ranges of soil test P. The Olsen, Bray I, or Morgan soil test P methods are required by the NRCS Idaho Nutrient Management Standard depending upon the soil pH. The soil test level for "plant available P" does not ascertain the total P in the surface soil. Rather, it gives an indication of the relative amount of total P that may be present because of the general relationship between the forms of P (organic, adsorbed, and labile P) and the solution P available for plant uptake. If a soil test P result is above the P threshold as identified in the Idaho Nutrient Management Standard (590), the category automatically defaults to CRITICAL. The threshold value differs depending

on whether there is a surface water concern (0-12" soil test used) or a ground water concern (18-24" soil test used).

P Fertilizer Application Rate
The P fertilizer application rate is the amount, in pounds per acre (lbs/ac), of commercial phosphate fertilizer (P_2O_5) applied to the soil. This phosphate fertilizer does not include phosphorus from organic sources that are recorded in Organic P Sources Application Rate.

P Fertilizer Application Method
The manner in which P fertilizer is applied to the soil affects potential P movement. Incorporation implies that the fertilizer P is buried below the soil surface. If fertilizer is surface applied on a field with surface runoff (natural or from irrigation) and there is no incorporation, it is considered a significant risk and therefore the category automatically defaults to CRITICAL.

Organic P Source Application Rate
The organic P application rate is the amount, in pounds per acre (lbs/ac), of potential phosphate (P_2O_5) contained in the manure and applied to the soil. This organic phosphate source does not include phosphorus from fertilizer sources that are recorded in P Fertilizer Application Rate.

Organic P Source Application Method
The manner in which organic P material is applied to the soil can determine potential P movement. Incorporation implies that the organic P material is buried below the soil surface. If manure is surface applied on a field with surface runoff (natural or from irrigation) and there is no incorporation, it is considered to be a discharge and a violation of existing regulations. Because of this, the category automatically defaults to CRITICAL.

Runoff Class/Runoff Index
Runoff Class: The runoff class of the site is used for non-irrigated lands. One method to determine the runoff class is based on the soil permeability and the percent slope of the site (USDA-NRCS Soil Survey Manual, Agricultural Handbook 18, 1993). This is the method used within ONEPLAN. The matrix relating soil permeability class and slope (Table 3) provides the value categories: NEGLIGIBLE, VERY LOW, LOW, MEDIUM, HIGH and VERY HIGH.

Runoff Index: The runoff index of the site is used for irrigated lands. For surface irrigated lands, the runoff index is:

$$RI = (1 - (Tf/Ts) \times 100$$

where Tf is the time to reach the end of the furrow, and Ts is the set time (both in hours). For sprinkler irrigated lands, the runoff index is simply the percent of irrigation water applied that runs off (user estimate).

Runoff Conservation Practices
Runoff conservation practices include any conservation practices which serve to reduce runoff and the movement of soil, thereby reducing potential for runoff phosphorus and/or sediment attached phosphorus movement across the landscape toward a receiving water body. Runoff conservation practices are separated into on-field and off-field categories. Off-field conservation

measures, like buffers, receive runoff from a given field and attempt to mitigate or reduce the eventual loss and transport of P to a receiving water body. The rating system utilized by the assessment progresses from a situation where there is little runoff risk and runoff conservation practices are in place, to severe runoff problems with no mitigating practices.

Soil Erosion

Soil erosion is defined as the loss of soil along the slope or unsheltered distance caused by the processes of water and wind. Soil erosion is estimated from erosion prediction models including the Revised Universal Soil Loss Equation (RUSLE/RUSLE2) for water erosion from non-irrigated lands (and sprinkler irrigated lands if runoff exists) and the Surface Irrigation Soil Loss equation (SISL) for water erosion from surface irrigated lands. The Wind Erosion Equation (WEQ) is generally not used in this assessment. The value category is given in tons of soil loss per acre per year (ton/ac/yr). These soil loss prediction models do not predict sediment delivery rates from the end of a field to a water body. The prediction models are used in this assessment to indicate the potential for sediment and attached phosphorus movement across the slope or unsheltered distance and toward a water body.

Distance to Nearest Receiving Water Body

The distance to the nearest receiving water body is the distance in feet between the edge of the field and the nearest receiving water body. The closer the distance the greater the likelihood that the majority of the phosphorus lost from the field will reach the receiving water body.

Procedures for Making an Assessment

Assessments can be made by hand using the Risk Assessment Worksheet (Attachment 1), or electronically using ID Phosphorus Transport Risk Assessment EXCEL spreadsheet (see Attachment 2). The nutrient management component of ONEPLAN contains the same Risk Assessment. The site characteristics were assigned a weighting based on probable contribution to potential phosphorus movement from the site. There is scientific basis for concluding that these relative differences exist; however, the absolute weighting factors given are currently based on professional judgment.

The site characteristic weighting factors are:

- Soil test phosphorus (1.00)
- P fertilizer application rate (0.75)
- P fertilizer application method (0.50)
- Organic P source application rate (1.00)
- Organic P source application method (0.75)
- Runoff class/runoff index (0.50)
- Runoff conservation practices (1.00)
- Soil erosion/irrigation erosion (1.00)
- Distance to nearest receiving water body (1.00)

A log base of 2 is used for the rating categories (with the exception of the CRITICAL rating). Therefore, a VERY LOW rating is assigned 0 points, while a VERY HIGH rating is assigned 8 points. The higher the point value, the greater the potential for significant problems related to phosphorus movement. The value ratings for each factor are provided in Table 1.

References

Cyzemmek, KJ, QM Ketterings, and L Geohring. 2001. Phosphorus and agriculture VIII: The new phosphorus index for New York state. What's Cropping Up? 11: 1-3.

Lemunyon, JL, and TC Daniel. 2002. Quantifying phosphorus losses from the agricultural system. J. Soil and Water Conservation 57: 399-401.

NRCS Conservation Practice Standard, Nutrient Management, Idaho 590.

NRCS, Engineering Technical Note, Series 1901. A Phosphorus Assessment Tool, August 1994.

Sharpley, AN, T Daniel, T Sims, J Lemunyon, R Stevens, and R Parry. 2003. Agricultural phosphorus and eutrophication (second edition). USDA-Agricultural Research Service, ARS-149.

Table 1. Phosphorus Transport Risk Assessment. The sum of all weighted rating values is used to determine the site vulnerability.

Site Characteristic	Factor Weight	Rating and Weight					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Soil Test (ppm) 0-12"	Olsen Method 1.0	< 8	8 - 15	15 - 25	25 - 35	35 - 40	> Threshold[1]
Soil Test (ppm) 0-12"	Bray I Method 1.0	< 10	10 - 20	20 - 40	40 - 50	50 - 60	> Threshold[1]
Soil Test (ppm) 0-12"	Morgan (NaOAc) Method 1.0	< 1.0	1.0 – 2.0	2.0 – 4.0	4.0 – 5.0	5.0 – 6.0	> Threshold[1]

[1] The threshold value for the critical rating depends on whether the field has a **ground water or surface water concern.** For surface water concerns, the threshold values for Olsen, Bray and Morgan, respectively, are 40 ppm, 60 ppm and 6 ppm determined at the 0 – 12" depth. For ground water concerns within 5 feet of the surface, the threshold for the soil test P determined at 18-24" is 20 ppm, 25 ppm or 2.5 ppm for Olsen, Bray and Morgan, respectively; if the ground water concern is > 5 feet, then the threshold is 30 ppm, 45 ppm or 4.5 ppm for Olsen, Bray and Morgan, respectively. All other rating categories only refer to surface water concerns and the 0-12" soil test.

Site Characteristic	Factor Weight	Rating and weight					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Phosphorus Fertilizer Application Rate (lbs/ac P_2O_5)	0.75	0	< 60	60 - 150	151- 300	> 300	

Site Characteristic	Factor Weight	Rating and weight					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Phosphorus Fertilizer Application Method	0.5	0	Placed with planter or injected > 2" or plowed	Incorporated > 3" by disking or chiseling, etc.	Irrigated or incorporated < 3" by harrowing, etc.	Surface applied, no incorporation	Surface applied on a field with surface runoff (natural or from irrigation) and no incorporation

Site Characteristic	Factor Weight	Rating and weight					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Organic Phosphorus Application Rate (lbs/ac P_2O_5)	1	0	< 40	40 - 100	101 - 200	> 200	

5226

Table 1. Continued.

Site Characteristic	Factor Weight	Rating and weight					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Organic Phosphorus Application Method	0.75	0	Injected > 2" or plowed	Incorporated > 3" by disking or chiseling, etc.	Irrigated or incorporated < 3" by harrowing, etc.	Surface applied, no incorporation	Surface applied, on a field with surface runoff (natural or from irrigation) and no incorporation.

Site Characteristic	Factor Weight	Rating and weight					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Runoff Index (Surface Irrigated)	0.5	< 10	10 - 20	20 - 40	40 - 60	> 60	
Runoff Index (Sprinkler Irrigated)	0.5	< 5	5 - 10	10 - 20	20 - 40	> 40	
Runoff Class (Non-irrigated)	0.5	Negligible	Very low or low	Medium	High	Very High	

Runoff Index for Surface Irrigated = [1 - (Time for water to reach end of furrow / Set time)] x 100
Runoff Index for Sprinkler Irrigated = (Amount runoff/amount water applied) x 100

Site Characteristic	Factor Weight	Rating and weight					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Runoff Conservation Practices	1	No runoff with conservation practices	No runoff with no conservation practices	Runoff with onsite and offsite conservation practices	Runoff with onsite or offsite conservation practices	Runoff with no conservation practices	

Site Characteristic	Factor Weight	Rating and weight					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Soil Erosion	1	0	< 5 tons/acre	5 - 10 tons/acre	10 - 15 tons/acre	> 15 tons/acre	

Site Characteristic	Factor Weight	Rating and weight					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Distance to Surface Water Body	1	> 2640 feet (> 0.5 mile)	2640 - 1320 feet	1319 - 600 feet	599 - 200 feet	< 200 feet	

527

Table 2. Phosphorus Transport Risk Assessment Index rating and sit e vulnerability.

Phosphorus Transport Risk Assessment Rating	Total	Site Vulnerability Chart
LOW	< 10	Low potential for phosphorus loss if current farming practices are maintained.
MEDIUM	10 - 20	Medium potential for phosphorus loss. Some remediation measures should be undertaken to minimize the probability of phosphorus loss.
HIGH	21 - 40	High potential for P loss and adverse effects on surface and/or ground waters. Soil and water conservation measures and phosphorus management plans are needed to reduce the probability of phosphorus loss.
VERY HIGH	> 40	Very high potential for phosphorus loss and adverse effects on surface and/or ground waters. All necessary soil and water conservation measures and a nutrient management plan must be implemented to minimize phosphorus loss from this field.

Table 3. The surface RUNOFF CLASS site characteristic determined from the relationship of the soil permeability class and field slope. Adapted from NRCS Soil Survey Manual (1993) Table 3-10.

Slope (%)	Soil Permeability Class [1] *(in/hr)*				
	Very Rapid *(>20.00 in/hr)*	Moderately Rapid and Rapid *(2.00 – 20.00)*	Moderately Slow and Moderate *(0.20 – 2.00)*	Slow *(0.06 - 0.20)*	Very Slow *(< 0.06 in/hr)*
	Runoff Class [3]				
Concave [2]	N	N	N	N	N
< 1	N	N	N	L	M
1 - 5	N	VL	L	M	H
5 - 10	VL	L	M	H	VH
10 - 20	VL	L	M	H	VH
> 20	L	M	H	VH	VH

[1] Permeability class of the least permeable layer within the upper 39 inches (one meter) of the soil profile. Permeability classes for specific soils can be obtained from a published soil survey or from local USDA-NRCS field offices (soils database).

[2] Area from which no or very little water escapes by overland flow.

[3] RUNOFF CLASS: N = negligible, VL = very low, L = low, M = medium, H = high, VH = very high.

Table 4. Management options to minimize nonpoint source pollution of surface waters by soil P (from Sharpley et al. 2003).

P Risk Assessment	Management Options
< 10 (Low)	***Soil testing:*** Test soils for P annually to monitor buildup or decline in soil P, and to determine if plant available P meets crop requirements. ***Soil conservation:*** Follow good soil conservation practices. Consider effects of changes in tillage practices or land use on potential for increased transport of P from site. ***Nutrient management:*** Consider effects of any major changes in agricultural practices on P loss *before* implementing them on the farm. Examples include increasing the number of animal units on a farm or changing to crops with a high demand for fertilizer P.
10 to 20 (Medium)	***Soil testing:*** Test soils for P annually to monitor buildup or decline in soil P, and to determine if plant available P meets crop requirements. Conduct a more comprehensive soil testing program in areas identified by the P Assessment as most sensitive to P loss by surface runoff, subsurface flow and erosion. ***Soil conservation:*** Implement practices to reduce P loss by surface runoff, subsurface flow, and erosion in the most sensitive fields (i.e., reduced tillage, field borders. grassed waterways. and improved irrigation and drainage management). ***Nutrient management:*** Any changes in agricultural practices may affect P loss. Carefully consider the sensitivity of fields to P loss before implementing any activity that will increase soil P. Avoid broadcast applications of P fertilizers and apply manure only to fields with low P Assessment values.
21 to 40 (High)	***Soil testing:*** A comprehensive soil testing program should be conducted on the entire farm to determine fields that are most suitable for further additions of P. For fields with excessive P in soils, estimate the time required to deplete soil P to optimum levels for use in long-range planning. ***Soil conservation:*** Implement practices to reduce P loss by surface runoff, subsurface flow, and erosion in the most sensitive fields (i.e., reduced tillage, field borders, grassed waterways, buffers, and improved irrigation and drainage management). Consider using crops with high P removal capacities in fields with high P Assessment values. ***Nutrient management:*** In most situations involving fertilizer P, only a small amount used in starter fertilizers is needed. Manure may be in excess on the farm and should only be applied to fields with lower P Assessment values. A long-term P management plan should be considered.
> 40 (Very High)	***Soil testing:*** For fields with excessive P in soils, estimate the time required to deplete soil P to optimum levels for use in long-range planning. Consider using new soil testing methods that provide more information on environmental impact of soil P. ***Soil conservation:*** Implement practices to reduce P loss by surface runoff, subsurface flow, and erosion in the most sensitive fields (i.e., reduced tillage, field borders, grassed waterways, buffers, and improved irrigation and drainage management). Consider using crops with high P removal capacities in fields with high P Assessment values. ***Nutrient management:*** Fertilizer and manure P should not be applied for 3 years or more. A comprehensive, long-term P management plan must be developed and implemented.

530

Use And Precautions of the Phosphorus Transport Risk Assessment

The Phosphorus Transport Risk Assessment is a planning tool that can be used in resource management plans, for water and soil quality, nutrient management and ecosystem based planning assistance in watersheds. Its intended use is to help the planner communicate to the land user the relative potential for phosphorus movement in the landscape. It can aid in identifying the critical parameters of soil, topography and management that most influence P movement. Using these parameters, the assessment can then help in the selection of management alternatives that would significantly address the potential impact and reduce phosphorus risk (Table 4). Quality criteria for surface and ground water resource concerns cite the NRCS Nutrient Management 590 practice standard. The *Additional Criteria to Protect Quality on Vulnerable Sites* section of the standard states that "resource and or environmental concerns identified by the analysis (assessment) will be addressed with inclusion of needed conservation practices to address the concern." A risk assessment of LOW to MEDIUM signifies that the producer should consider including conservation practices in their conservation plan that will correct or mitigate for identified resource concerns. A risk assessment of HIGH or CRITICAL requires that the producer plan and apply conservation practices which will correct or mitigate for the resource concern(s) identified during the planning process.

THE PHOSPHORUS TRANSPORT RISK ASSESSMENT IS NOT INTENDED TO EVALUATE WHETHER LAND USERS ARE ABIDING WITHIN REGULATORY RULES OR LAWS THAT HAVE BEEN ESTABLISHED BY LOCAL, STATE, OR FEDERAL AGENCIES. Any attempt to use this assessment at a regulatory scale would be grossly beyond the intent of the assessment tool and the concept and philosophy of the working group that developed the assessment. The NRCS does not condone or promote the use of the assessment for placing any restrictions on land use or other regulatory purposes that could be construed by manipulating the parameters of the assessment. Field testing of the assessment is one of the most appropriate methods for determining the value of the assessment and whether it is giving valid and reasonable results.

ATTACHMENT 1: Conducting a Risk Analysis by Hand

Complete the heading on the Idaho Phosphorus Risk Assessment Worksheet, and enter the Tract and Field numbers in columns A - F. Planning units which have more than six fields will require additional worksheets. Note that each column is divided into 2 subcolumns below the tract and field numbers. The first subcolumn is the *"RATING"* and the second subcolumn is *"RATING X FW"*. The value rating for a given site characteristic derived from Table 1 is entered in the first subcolumn on the Worksheet, then multiplied by the weighting factor (FW) for that site characteristic. The result is entered in the second subcolumn. The process is repeated for each site characteristic and then totaled at the bottom of the second subcolumn for each field. The total is used to determine the overall Risk Level for each field using the Site Vulnerability Chart below the worksheet.

Example:

1. The Olson soil test for Field A is 15 ppm.
2. From Table 1, an Olson soil test value of 15 ppm results in a medium rating. Medium ratings have a value of 2.
3. The value 2 is entered in the first subcolumn for Field A.
4. Multiply the rating value of 2 by the Factor Weight (in this case 1.0) to get the weighted value for that site characteristic and enter in the second subcolumn. In this case, the value of 2 X Factor Weight of 1 = 2. The weighted value of 2 is entered in the second subcolumn. Repeat process for each characteristic of the assessment.
5. Sum the weighted values for all nine characteristics, and compare the total with the Site Vulnerability chart at the bottom of the Worksheet to determine the final rating for that field.

IDAHO PHOSPHORUS TRANSPORT RISK ASSESSMENT

Landowner: _____ Date: _____ Pg: __ of __

Location: _____ Condition: Before _____ After: _____

Planner: _____ Field Office: _____

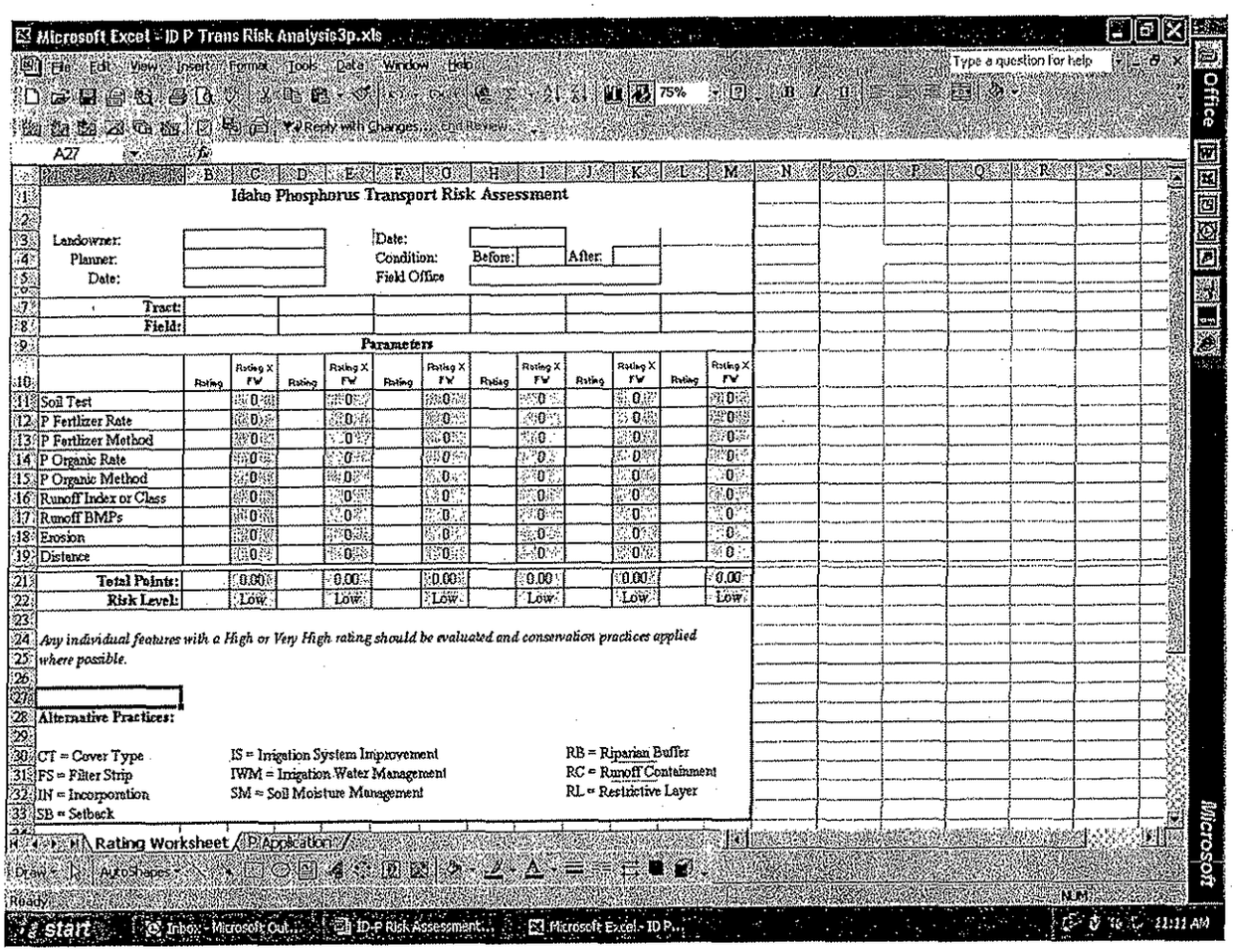
	A		B		C		D		E		I	
Tract												
Field(s)												
	Rating	Rating X FW	Rating	Rating X FW	Rating	Rating X FW	Rating	Rating X FW	Rating	Rating X FW	Rating	Rating X FW
Soil Test P *Factor Weight (FW) = 1.0*												
P Fertilizer Rate *Factor Weight (FW) = 0.75*												
P Fertilizer Method *Factor Weight (FW) = 0.50*												
P Organic Rate *Factor Weight (FW) = 1.0*												
P Organic Method *Factor Weight (FW) = 0.75*												
Runoff Index (Irrigated) **OR** Runoff Class (Not Irrigated) *Factor Weight (FW) = 0.50*												
Runoff Conserv. Practices *Factor Weight = 1.0*												
Soil Erosion *Factor Weight = 1.0*												
Distance to Water Body *Factor Weight = 1.0*												
Total Points												
Risk Level												

P Index Rating	Total	Site Vulnerability Chart
Low	< 10	Low potential for phosphorus loss. Some remediation measures should be undertaken to minimize the probably loss.
Medium	10 - 20	Medium potential for phosphorus loss. Some remediation measures should be undertaken to minimize the probability of phosphorus loss.
High	21- 40	High potential for P loss and adverse effects on surface and/or ground waters. Soil and water conservation measures and phosphorus management plans are needed to reduce the probability of phosphorus loss.
Very High	> 40	Very high potential for phosphorus loss and adverse effects on surface and/or ground waters. All necessary soil and water conservation measures and a phosphorus management plan must be implemented to minimize phosphorus loss from this field.

ATTACHMENT 2: Conducting a Risk Analysis using ID Phosphorus Transport Risk Assessment EXCEL Spreadsheet

Access the spreadsheet and immediately rename it. There are two tabs at the bottom of the spreadsheet, the "Rating Worksheet" and "P Application". The Rating Worksheet is used to input the ratings determined from either the P Application sheet or Table 1 in this Technical Note.

1. Select the Rating Worksheet and complete the heading.
2. Reference Table 1 or the P Application sheet and determine the rating (e.g. Very Low, Low, etc.) for the appropriate site characteristic.
3. Determine the corresponding rating. For example, an Olson soil test of 15 ppm has a Medium rating and a rating value of 2.
4. Click on the appropriate cell and select the correct rating value from the drop down list. The program automatically calculates the weighted value of each rating as it is entered, totals it at the bottom and determines the overall Risk Level.



534

ATTACHMENT 3: Example for Conservation Planning

Site Characteristic and Rating Value .	Factor Weighting X Rating Value
Soil P test is 35 ppm using an Olsen Test =HIGH (value = 4) [Field has a surface water resource concern]	1.0 x 4 = 4.0
P fertilizer application rate is 50 lbs/ac P_2O_5 =LOW (value = 1)	0.75 x 1 = 0.75
P fertilizer application method is placed with planter =LOW (value = 1)	0.5 x 1 = 0.5
Organic P source application rate is 210 lbs/ac =VERY HIGH (value = 8)	1.0 x 8 = 8.0
Organic P source application method is incorporated less than 3 inches by harrowing, etc. =HIGH, (value =4)	0.75 x 4 = 3.0
Runoff class from Table 3 is Medium =MEDIUM (value = 2)	0.5 x 2 = 1.0
Runoff conservation practices is runoff with no on-field or off-field practices =VERY HIGH (value = 8)	1.0 x 8 = 8.0
Soil erosion is 7.5 tons/ac/yr = MEDIUM (value = 2)	1.0 x 2 = 2.0
Distance to nearest receiving water body is 300 feet =HIGH (value = 4)	1.0 x 4 = 4.0
	Sum total of all weighted values = 30.25

Site Vulnerability is **HIGH**

HIGH - This site has a HIGH potential for P loss and adverse effects on surface and/or ground waters. Soil and water conservation measures and phosphorus management plans are needed to reduce the probability of phosphorus loss.

535

Using the individual site characteristics, identify some factors of concern and management options that could be used to reduce this site vulnerability:

Soil P Test – The soil P test was HIGH. Remember that the soil test level for "available P" does not ascertain the total P in the surface soil. It does, however, give an indication of the amount of total P that may be present because of the general relationship between the forms of P and the solution P available for crop uptake. Research has conclusively shown that the higher the soil test P level of a site, the proportionately higher the potential P loss will be from that site. Therefore the long-term goal should be to conduct a comprehensive soil testing program on the entire farm to determine fields with lower soil test P levels that are more suitable for additions of phosphorus. For fields with excessive P levels, estimates should be made to determine the time required to deplete the soil P to optimum levels.

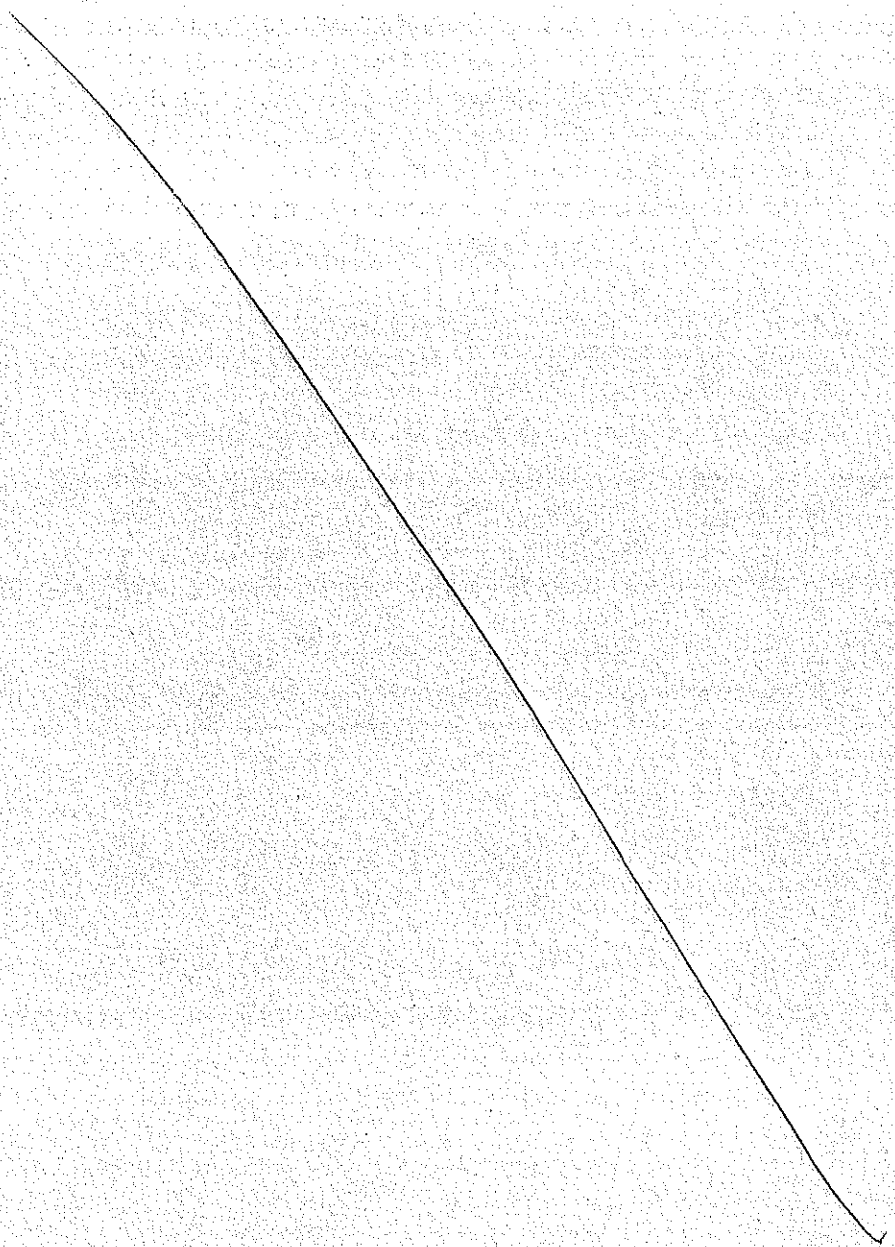
Organic P Source Application Rate – The organic P source application rate was > 200 lbs/ac, falling in the VERY HIGH category. This particular site characteristic is especially important. Here we have a field with a soil test P level that is already high and very high rates of organic P are being applied. Considering the long-term management options discussed under Soil P Test, the organic P application rate should either be reduced to crop P uptake or less, or no organic P should be applied to this field until the soil P is depleted back to an optimal level. The organic P material should be applied to fields with lower soil P test and Vulnerability Assessment values.

Organic P Source Application Method – The organic P source application method was incorporated less than 3 inches with a harrow, etc. putting it in the HIGH category. Remember that the manner in which organic P material is applied to the soil can determine potential P movement. Since the organic P was only minimally incorporated, the organic P would still have a substantial surface exposure. Mechanical incorporation reduces the amount of nutrients in the thin mixing zone at the soil surface and/or on crop residue or foliage, thus reducing the interaction with and transfer of nutrients to runoff water. With incorporation, other environmental losses may also be reduced, and nutrient management may be improved. However, mechanical incorporation with tillage may reduce soil protecting crop residue and increase erosion. Incorporated material may be subject to downward movement. Leaching losses may be increased, and the relative importance of the different loss pathways needs to be considered. The organic P material should be injected or plowed greater than 2 inches if possible, and applied immediately before the crop is planted.

Runoff Conservation Practices – Since there was runoff with no conservation practices in place, this factor fell into the VERY HIGH category. By implementing both on-site and off-site conservation measures, this site factor could be greatly reduced (see Soil Erosion).

Soil Erosion – The soil erosion rate was 7.5 tons/ac/yr (MEDIUM category). Prediction models are used in the assessment to indicate a movement of soil, thus potential for sediment and attached phosphorus movement across the slope or unsheltered distance and to a water body. Conservation measures such as residue management or reduced tillage should be considered as a way to reduce erosion. In addition, other conservation measures like field borders, grassed waterways, buffers and improved drainage management should be considered as a means to mitigate off-site transport and improve the quality of runoff leaving the field.

Sites with a vulnerability rating greater than LOW (especially those in the HIGH and VERY HIGH category) have the greatest potential to adversely impact surface water quality. The assessment can be used to identify management options available to land users and will allow them flexibility in developing remedial strategies. The first step is to address areas adjacent to sensitive waters and prioritize the efforts needed to reduce P losses. Then, management options appropriate for soils with different P risk assessment ratings can be implemented. General recommendations are given in Table 4. However, P management is very site specific and requires a well-planned, coordinated effort among farmers, extension agronomist and soil conservation specialist. The risk level can be reduced by planning conservation practices which will mitigate off-site transport of phosphorus. For example, a particular field has a soil erosion rate of 13 tons/acre. That erosion rate falls into the HIGH soil erosion rating and has a value of 4. To correct the problem, the producer applies a suitable system of BMPs and reduces the erosion rate to < 5 tons/acre. A LOW rating of 1 is now used to determine the overall risk.



TECHNICAL NOTES

USDA-Natural Resources Conservation Service
Boise, Idaho

TN – Water Quality No. 4 *August 2005*

NITROGEN TRANSPORT RISK ASSESSMENT

This Nitrogen Transport Risk Assessment is a 5 x 5 matrix that uses a limited number of site and management characteristics to determine the probability of off-site transport of nitrogen. Off-site transport refers primarily to transport below the crop root zone, although other mechanisms include transport in overland flow and gaseous losses. The assessment is part of an overall planning process imbedded within the ONEPLAN Nutrient Management Planner program. The assessment, together with a nutrient management plan, is used as a tool for understanding the contributions that individual landform and management parameters have on nitrogen transport and the potential for applied conservation practices (Best Management Practices) to mitigate situations where transport/loss can occur.

Nitrogen Concerns in the Environment

Concerns about agriculture's role in nitrogen (N) delivery to the environment have increased over the past decade. Nitrogen is a major input to crop and livestock production, and industrial production of N fertilizers has resulted in increased yields and more intensive agricultural operations. However, nitrogen use efficiency of most agricultural systems is currently estimated at only 30 - 50% worldwide, leading to nitrogen losses that degrade air and water quality.

One of the most widespread contaminants in Idaho ground water related to land use is nitrate. This is a major concern, since more than 90% of Idahoans get their drinking water from ground water sources. Twenty-five nitrate priority areas have been designated by the Idaho Department of Environmental Quality. Of those areas with sufficient data for trend analysis, 35% showed long-term increases in nitrate concentration and 40% demonstrated short-term increases. The southern portion of the state is especially impacted, where contamination is correlated with large nitrogen inputs and the vulnerability of the Snake River Plain Aquifer. Vulnerability is determined by the intrinsic susceptibility of the aquifer based on physical properties, coupled with management factors.

Water carrying nitrates and other contaminants can take decades to flow through the soil substrate. Schumann et al. (2002) calculated nitrate movement at 1 m/year through silt loam soils. ARS watershed studies in Iowa found that nitrates applied to soil took nearly 30 years to reach a 70-ft deep water table (Pons 2003). The slow rate of movement and lack of dilution in saturated zones means that contamination may persist for a long time period, even with improvements in management. Surface waters can also be degraded by nitrogen. The high flux of nitrates in streams during irrigation season can result from both overland flow and from groundwater inflow.

539

Nitrogen Movement in the Landscape

Nitrogen is one the most dynamic and mobile nutrients in the plant-soil-air continuum, with many pathways for loss (Figure 1). There is a large reservoir of N in soil, but most of this is in the organic form. Organic N is mineralized through microbial action under typical soil conditions to ammonium. Oxidation by specialized bacteria rapidly converts ammonium to nitrite and then nitrate (nitrification) under optimum conditions of soil temperature, aeration and moisture. The mineralized form of N (nitrate and ammonium) is readily available for uptake by plants. It is estimated that only 2-3% of organic N is mineralized annually. Therefore, intensive agricultural systems rely on inputs of fertilizer N to meet crop and animal demands.

The N cycle is both spatially and temporally variable within agricultural systems. Variability of soil properties impacts nitrogen movement and loss within agricultural operations, including soil organic matter, residual nitrate, crop residue amount, crop yield variability, and changes in soil chemical and physical properties across the field. Losses of nitrogen to the air can occur through denitrification of nitrate or volatilization of ammonia. Nitrogen can also be lost in solution, or attached to soil and organic matter, via overland flow. The primary loss mechanism of nitrogen in agricultural systems, however, is leaching of nitrate below the root zone. Nitrate is a negatively charged ion that is highly mobile in the soil. The amount of water that percolates through and below a crop's root zone is important in determining the amount of nitrate leached. Soil, crop, climate and management factors interact to determine the amount of percolation.

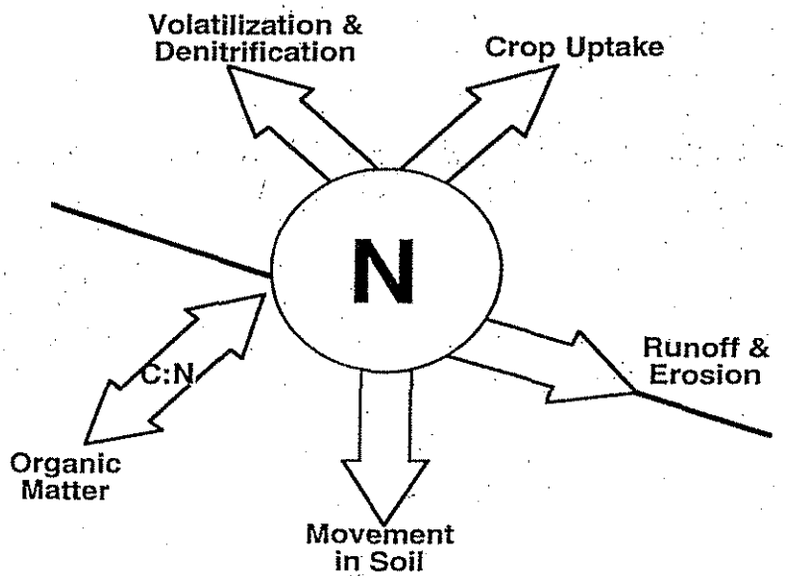


Figure 1. A simplified nitrogen cycle (Source: NRCS-NEDC 2001).

540

Management plays a critical role in reducing N loss to the environment, and management is the dominant factor influencing long-term nitrate leaching (Shaffer et al. 2002). Soil, climate, watershed and aquifer characteristics must also be taken into account in order to minimize nitrate leaching. Loss of nitrate from agricultural systems can range from 0 - 60% of N applied. In grain production systems, 10 - 30% was the average loss observed (Meisinger and Delgado 2002). Leaching loss is dependent on the concentration of N in soil solution and the volume of water leached. Over-irrigation can lead to nitrate leaching, especially with shallow rooted crops. Effective management is therefore aimed at reducing transport through proper irrigation water management, and optimizing N application amounts and timing in concert with crop uptake. Crop type and cultivation are also important considerations.

Idaho's Nitrogen Transport Risk Assessment

The purpose of the Nitrogen Transport Risk Assessment is to provide field staffs, watershed planners, and land users with a tool to assess the various landforms and management practices for potential risk of nitrogen movement to aquifers and other water bodies.

Shaffer et al. (2002) describe the need for, and the basic elements of, a national nitrate leaching assessment tool. The impacts of crop type, fertilizer, manure and irrigation management, coupled with soils, climate, and watershed factors, are essential parameters of this leaching index. The index would utilize a tiered structure dependent on potential risk:

- Tier 1: Broad-based screening tool that identifies risk level based on controlling factors. Areas identified with higher risk levels would warrant further study (Tier 2, 3).
- Tier 2: Larger-scale quantification of nitrate leaching using appropriate modeling tools.
- Tier 3: Site-specific quantification of nitrate leaching based on current management and site conditions through field studies and research models.

The Idaho Nitrogen Transport Risk Assessment is a Tier 1 screening tool that addresses the key factors identified by Shaffer et al. (2002). A number of climate, soil, hydrology and aquifer site characteristics describe the landform, along with management factors. The Nitrogen Transport Risk Assessment (Table 1) is a simple 5 by 5 matrix utilizing parameters that influence nitrogen availability, retention, management and movement.

There are five site characteristics used in the assessment to evaluate a particular site. Each site characteristic is rated VERY LOW/NOT APPLICABLE, LOW, MEDIUM, HIGH or VERY HIGH by determining the range for each category. A log base of 2 is used for the rating categories. Therefore, a VERY LOW rating is assigned 0 points, while a VERY HIGH rating is assigned 8 points. The higher the point value, the greater the potential for significant problems related to nitrogen movement (Table 1). Particular site characteristics may be more prominent than others in allowing potential nitrogen movement (primarily leaching) from the site. There is

scientific basis for concluding that these relative differences exist; however, the absolute weighting factors assigned to site characteristics to reflect these differences are currently based on professional judgment.

The site characteristics and weighting factors are:

- Deep percolation risk (2.00)
- Irrigation efficiency (1.00)
- N application rate (1.00)
- N application timing (1.00 if non-irrigated, 0.75 if irrigated)
- Water table depth/soil type (1.00 if irrigated, 1.5 if non-irrigated)

The sum of the site characteristic rankings provides an index of the potential for off-site nitrogen transport, primarily leaching through the root zone (Table 2). A description of each site characteristic and the factors that are used in their determination follows.

Deep Percolation Risk

Deep percolation is dependent on numerous factors, including climate, soil type and irrigation efficiency. The deep percolation factor for sprinkler-irrigated fields is determined from daily evapotranspiration (ET) rates for an individual crop type, totaled over the irrigation season using local climate station data. Total deep percolation loss is calculated from monthly deep percolation loss from a simple water budget developed within ONEPLAN. Deep percolation risk for sprinkler irrigated fields is then calculated as the ratio of deep percolation to total ET, over the irrigation season. For surface-irrigated fields, deep percolation risk is based on the highest monthly deep percolation loss (a relative comparison of the percent water applied that percolates below the root zone in any given month). For non-irrigated fields, nitrogen loss risk is based on the New York Nitrogen Leaching Index (Czymmek et al. 2003) which is essentially a water percolation index based on soil water storage. Slight modifications were made to some of the percolation index equations to adjust for low precipitation zones found in areas of Idaho. Total annual precipitation for specific locations is determined from local climate station data, as is winter precipitation. The percolation index is based on precipitation and hydrologic group. A seasonal index is calculated as the ratio of winter precipitation to annual precipitation. The deep percolation risk is then calculated as the product of the percolation index and seasonal index.

Irrigation Efficiency

Managing irrigation water will minimize nitrogen losses from leaching and surface runoff. Irrigation efficiency and irrigation water management have significant impacts on water movement through the root zone. Monthly NIR (net irrigation requirement) values are determined for crop type based on ET estimates. For sprinkler-irrigated fields, total irrigation water applied is adjusted for system efficiency and runoff to determine season-long irrigation efficiency (NIR/net water applied). For surface-irrigated fields, the lowest monthly irrigation efficiency for the season is used as the index.

N Application Index

Crop nitrogen requirement is determined based on crop yield and University of Idaho fertilizer recommendations. Total available nitrogen is determined from all sources, including prior year

crops. The application index is the ratio of the total N available (application N plus surplus/residual N) to the crop nitrogen requirement.

N Application Timing

Timing of N application directly influences potential transport due to the high mobility of nitrate in soils. The appropriate timing of N application is complicated by the soil processes of nitrification and mobilization, which affect N plant availability. Split applications of N better match crop growth requirements, reducing the likelihood of loss. Fall application in most instances has the greatest potential for loss prior to planting season, and then additional N applications are required to meet crop demand.

Water Table Depth/Soil Type

Soils can stop or slow nitrogen movement depending on their chemical and physical characteristics. Depth of soils, depth to water tables and limiting layers such as hard pans will influence rooting depth, nitrogen movement, and leaching potential. Fine textured soils (Hydrologic Group D) have a lower potential for leaching due to reduced hydraulic conductivity, while coarse textured soils (Hydrologic Group A) have a higher likelihood of nitrate leaching due to the rapid infiltration and movement of water through the profile. If a water table is present within five feet of the surface, the potential for ground water contamination is high despite the soil type.

Making an Assessment Using the Nitrogen Transport Risk Assessment Tool

It is recommended that assessments for nitrogen movement be done within the context of nutrient management planning using the Idaho ONEPLAN. If done manually, the user would need to obtain climatic data for the local area and crop nutrient and water requirements, as well as irrigation application information and soil and hydrologic characteristics.

References

Czymmek, KJ, QM Ketterings, HM van Es, and SD DeGloria. 2003. The New York Nitrate Leaching Index. Cornell University, Department of Crop and Soil Sciences, Extension Publication E03-2.

Delgado, JA. 2002. Quantifying the loss mechanisms of nitrogen. J. Soil and Water Conservation 57: 389 – 398.

Donato, MM. 2000. Probability of detecting atrazine/desethyl-atrazine and elevated concentrations of nitrite plus nitrate as nitrogen in ground water in the Idaho part of the Western Snake River Plain. USGS Water Resources Investigations Report 00-4163.

Focazio, MJ, TE Reilly, MG Rupert, and DR Helsel. 2003. Assessing ground water vulnerability to contamination: providing scientifically defensible information for decision makers. USGS Circular 1224.

Follet, RF, and JA Delgado. 2002. Nitrogen fate and transport in agricultural systems. J. Soil and Water Conservation 57: 402 – 408.

Meisinger, JJ, and JA Delgado. 2002. Principles of managing nitrogen leaching. J. Soil and Water Conservation 57: 485 - 498.

Mosier, AR, JW Doran, and JR Freney. 2002. Managing soil denitrification. J. Soil and Water Conservation 57: 505-513.

Neely, K. 2002. Nitrate results from the statewide program, 1991-2000. IDWR Technical Summary (IDWR website).

NRCS-NEDC (National Employee Development Center). 2001. Nutrient and pest management considerations in conservation planning: course materials.

Parliman, DJ. 2002.Analysis of nitrate concentration trends in 25 ground water quality management areas, Idaho. USGS Water Resources Investigations Report 02-4056.

Pons, L. 2003. Old soil study uncovers value of long-term nitrate research. ARS News Service, December 10, 2003.

Rupert, MG. 1996. Major sources of nitrogen input and loss in the upper Snake River Basin, Idaho and western Wyoming, 1990. USGS Water Resources Investigations Report 96-4008.

Rupert, MG. 1998. Probability of detecting atrazine/desethyl-atrazine and elevated concentrations of nitrite plus nitrate as nitrogen in ground water in the Idaho part of the upper Snake River Basin. USGS Water Resources Investigations Report 98-4203.

Shaffer, MJ, and JA Delgado. 2002. Essentials of a national nitrate leaching index assessment tool. J. Soil and Water Conservation 57: 327 - 335.

van Es, HM, KJ Czymmek, and QM Ketterings. 2002. Management effects on nitrogen leaching and guidelines for a nitrogen leaching index in New York. J. Soil and Water Conservation 57: 499 - 504.

Williams, JR, and DE Kissel. 1991. Water percolation: an indicator of nitrogen-leaching potential. pp 59-83 *IN*: RF Follet, DR Keeney, and RM Cruse (eds). Managing nitrogen for groundwater quality and farm profitability. Soil Science Society of America, Inc. Madison, WI

Table 1. Nitrogen Transport Risk Assessment. Sum of all weighted rating values is used to determine the site vulnerability.

Site Characteristic	Factor Weight	Rating and Weight				
		Very Low or N.A. 0	Low 1	Medium 2	High 4	Very High 8
Deep Percolation	Sprinkler Irrigated 2.0	< 5	5 - 10	10 - 20	20 - 40	> 40
	Surface Irrigated 2.0	< 10	10 - 20	20 - 30	30 - 40	> 40
	Non-Irrigated 2.0	0	0 – 2	2 – 5	5 – 10	>10
Irrigation Efficiency	Sprinkler Irrigated 0.75	> 90	80 - 90	60 - 80	50 – 60	< 50
	Surface Irrigated 0.75	> 90	75 - 90	60 - 75	40 - 60	< 40
N Application Rate- % of Crop Requirement	1.0	< 80	80 - 120	120 - 140	140 - 180	> 180
N Application Timing	Non-Irrigated 1.0 Irrigated 0.75	None applied	Split application with nitrification inhibitor	Split application	Preplant application in spring	Preplant application in fall
Water Table Depth and Soil Type	Non-Irrigated 1.0 Irrigated 1.5	Water table > 5 feet from surface, Hydrologic Group D	Water table > 5 feet from surface, Hydrologic Group C	Water table > 5 feet from surface, Hydrologic Groups A, B	Water table at surface, ponded, < 5 feet to surface, Hydrologic Groups C, D	Water table at surface, ponded, < 5 feet to surface, Hydrologic Groups A, B

Table 2. Nitrogen Transport Risk Assessment Index rating and site vulnerability.

Nitrogen Transport Risk Assessment Index Rating	Total	Site Vulnerability Chart
LOW	< 9	Low potential for nitrogen loss if current farming practices are maintained.
MEDIUM	9 - 16	Medium potential for nitrogen loss. Some remediation measures should be undertaken to minimize the probability of loss.
HIGH	16 - 25	High potential for N loss and adverse effects on ground water. Soil and water conservation measures and nitrogen management plans are needed to reduce the probability of loss.
VERY HIGH	>25	Very high potential for nitrogen loss and adverse effects on ground water. All necessary soil and water conservation measures and a nutrient management plan must be implemented to minimize loss from this field

ATTACHMENT 1: Example for Conservation Planning

Surface-irrigated crop: sugarbeet – onion – small grain rotation on silty clay loam, water table at 10 feet [Field has a ground water resource concern as defined in ONEPLAN]

Site Characteristic and Rating Value	Factor Weighting X Rating Value
Deep Percolation Risk is 35 = HIGH (value = 4)	2.0 x 4 = 8.0
Irrigation Efficiency is 35 =VERY HIGH (value = 8)	0.75 x 8 = 6.0
N Application Index is 160 =HIGH (value = 4)	1.0 x 4 = 4.0
N Application Timing is Split Application =MEDIUM (value = 2)	0.75 x 2 = 1.5
Water Table Depth and Soil Type =LOW, (value =1)	1.5 x 1 = 1.5
	Sum total of all weighted values = 21.0

Site Vulnerability is **HIGH**

HIGH - This site has a high potential for N loss and adverse effects on ground and/or surface waters. Soil and water conservation measures and nitrogen management plans are needed to reduce the probability of nitrogen loss.

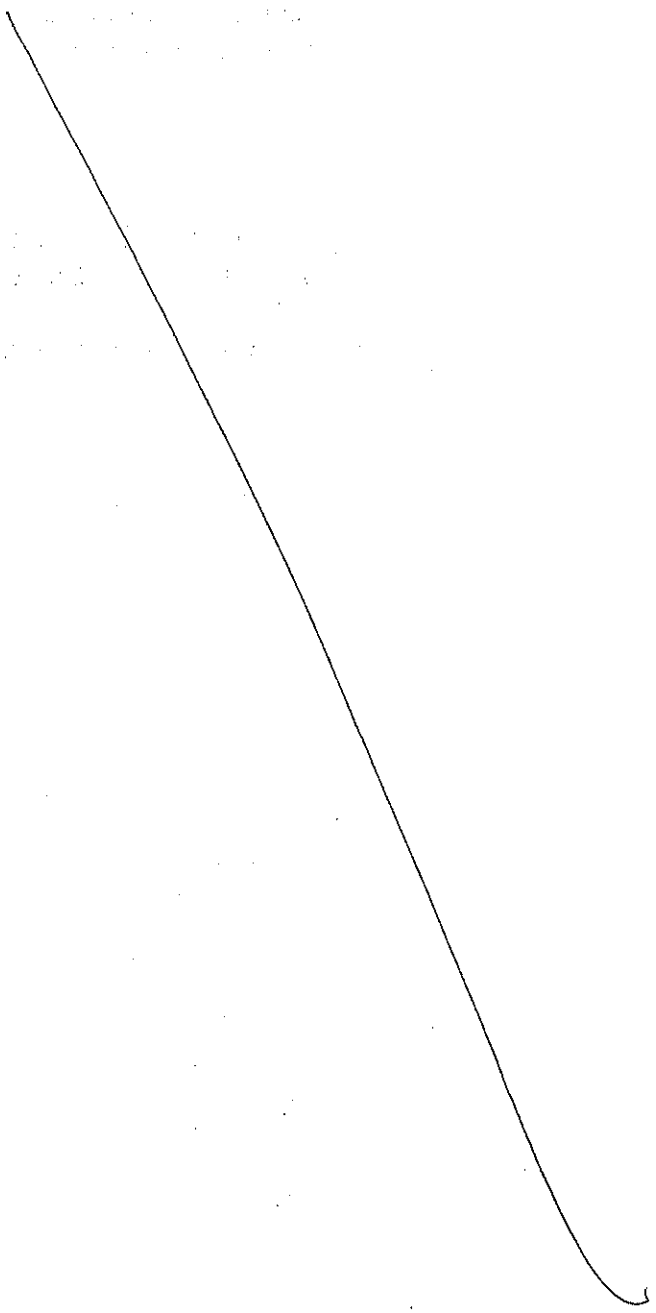
Using the individual site characteristics, identify some factors of concern and management options that could be used to reduce this site vulnerability:

Deep Percolation Risk – The deep percolation risk is HIGH – there is a high potential for nitrate leaching to occur. Apply irrigation water according to crop requirements. Do not apply nitrogen prior to leaching events. Water logging and poor soil aeration may negatively affect crop yields in some areas of field.

Irrigation Efficiency – The irrigation efficiency index under furrow-irrigation with siphon tubes is VERY HIGH (inefficient). Careful management of soil moisture with irrigation scheduling is needed. Be sure that the right amount of irrigation water is applied as uniformly as possible to meet crop needs and minimize leaching from the root zone – consider converting to surge or sprinkler irrigation. Check with irrigation professional to assure that crop growth requirements are being adequately met.

Nitrogen Application Index – The total nitrogen application was HIGH. The potential for nitrogen leaching exists if excess water is applied from irrigation and/or precipitation events. There is potential for detrimental effects of high nitrogen on crop production and quality. Use soil and/or plant tissue tests and appropriate fertilizer recommendations to determine nutrient application rates, taking into account residual N.

The example described above has a high probability for an adverse impact to ground water quality if existing management is not adjusted to reduce the site vulnerability. Sites with a vulnerability rating greater than LOW (especially those in the HIGH and VERY HIGH category) have the greatest potential to adversely impact ground water quality. The assessment can also be used to identify management options available to land users and will allow them flexibility in developing remedial strategies. The first step is to determine the management options appropriate for sites with different N vulnerability assessments. N management is very site-specific and requires a well-planned, coordinated effort between the farmer, extension agronomist and soil conservation specialist. The risk level can be reduced by planning conservation practices and management techniques which will mitigate leaching of nitrate. For example, a particular field has an irrigation efficiency risk rating of VERY HIGH. To correct the problem, the producer applies irrigation water management practices coupled with conversion to surge irrigation to provide more uniform soil moisture to the crop, based on crop demand. With these changes, a MEDIUM rating of 2 is now used to describe the overall risk due to irrigation efficiency.



RISK ANALYSIS EXERCISE

Conditions / Data Input:

- After (Planned) condition
- Soil test laboratory method: Olson
- Soil test Phosphorus 11 ppm
- Phosphorus fertilizer application rate: 40 lbs/ac
- Phosphorus fertilizer application method Placed with Planter
- Organic phosphorus application rate 56 lbs/ac
- Organic phosphorus application method disked 6 inches Deep
- Surface Irrigated – Runoff Index
    - Runoff Index formula from page 4 of the Technical Note:
      RI = (1 – (Tf / Ts) X100
      Where: Tf = time to reach the end of the row
      Ts = set time

        - ❑ Time to reach the end of the row: 4 hours
        - ❑ Set time: 12 hours
- Runoff Conservation Practices: Runoff with onsite & off site conservation practices
- Soil Erosion: < 5 tons/ac/yr
- Distance to Surface Water Body < 200 feet

Table 1. Phosphorus Transport Risk Assessment. The sum of all weighted rating values is used to determine the site vulnerability.

Site Characteristic	Factor Weight	Rating and Weight					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Soil Test (ppm) 0-12"	Olsen Method 1.0	< 8	8 - 15	15 - 25	25 - 35	35 - 40	> Threshold[1]
Soil Test (ppm) 0-12"	Bray I Method 1.0	< 10	10 - 20	20 - 40	40 - 50	50 - 60	> Threshold[1]
Soil Test (ppm) 0-12"	Morgan (NaOAc) Method 1.0	< 1.0	1.0 – 2.0	2.0 – 4.0	4.0 – 5.0	5.0 – 6.0	> Threshold[1]

[1] The threshold value for the critical rating depends on whether the field has a **ground water or surface water concern.** For surface water concerns, the threshold values for Olsen, Bray and Morgan, respectively, are 40 ppm, 60 ppm and 6 ppm determined at the 0 – 12" depth. For ground water concerns within 5 feet of the surface, the threshold for the soil test P determined at 18-24" is 20 ppm, 25 ppm or 2.5 ppm for Olsen, Bray and Morgan, respectively; if the ground water concern is > 5 feet, then the threshold is 30 ppm, 45 ppm or 4.5 ppm for Olsen, Bray and Morgan, respectively. All other rating categories only refer to surface water concerns and the 0-12" soil test.

Site Characteristic	Factor Weight	Rating and weight					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Phosphorus Fertilizer Application Rate (lbs/ac P_2O_5)	0.75	0	< 60	60 - 150	151- 300	> 300	

Site Characteristic	Factor Weight	Rating and weight					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Phosphorus Fertilizer Application Method	0.5	0	Placed with planter or injected > 2" or plowed	Incorporated > 3" by disking or chiseling, etc.	Irrigated or incorporated < 3" by harrowing, etc.	Surface applied, no incorporation	Surface applied on a field with surface runoff (natural or from irrigation) and no incorporation

Site Characteristic	Factor Weight	Rating and weight					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Organic Phosphorus Application Rate (lbs/ac P_2O_5)	1	0	< 40	40 - 100	101 - 200	> 200	

551

Table 1. Continued.

Site Characteristic	Factor Weight	Rating and weight					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Organic Phosphorus Application Method	0.75	0	Injected > 2" or plowed	Incorporated > 3" by disking or chiseling, etc.	Irrigated or incorporated < 3" by harrowing, etc.	Surface applied, no incorporation	Surface applied, on a field with surface runoff (natural or from irrigation) and no incorporation.
Site Characteristic	**Factor Weight**	**Rating and weight**					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Runoff Index (Surface Irrigated)	0.5	< 10	10 - 20	20 - 40	40 - 60	> 60	
Runoff Index (Sprinkler Irrigated)	0.5	< 5	5 - 10	10 - 20	20 - 40	> 40	
Runoff Class (Non-irrigated)	0.5	Negligible	Very low or low	Medium	High	Very High	

Runoff Index for Surface Irrigated = [1 - (Time for water to reach end of furrow / Set time)] x 100
Runoff Index for Sprinkler Irrigated = (Amount runoff/amount water applied) x 100

Site Characteristic	Factor Weight	Rating and weight					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Runoff Conservation Practices	1	No runoff with conservation practices	No runoff with no conservation practices	Runoff with onsite and offsite conservation practices	Runoff with onsite or offsite conservation practices	Runoff with no conservation practices	
Site Characteristic	**Factor Weight**	**Rating and weight**					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Soil Erosion	1	0	< 5 tons/acre	5 - 10 tons/acre	10 - 15 tons/acre	> 15 tons/acre	
Site Characteristic	**Factor Weight**	**Rating and weight**					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Distance to Surface Water Body	1	> 2640 feet (> 0.5 mile)	2640 - 1320 feet	1319 - 600 feet	599 - 200 feet	< 200 feet	

Table 2. Phosphorus Transport Risk Assessment Index rating and site vulnerability.

Phosphorus Transport Risk Assessment Rating	Total	Site Vulnerability Chart
LOW	< 10	Low potential for phosphorus loss if current farming practices are maintained.
MEDIUM	10 - 20	Medium potential for phosphorus loss. Some remediation measures should be undertaken to minimize the probability of phosphorus loss.
HIGH	21 - 40	High potential for P loss and adverse effects on surface and/or ground waters. Soil and water conservation measures and phosphorus management plans are needed to reduce the probability of phosphorus loss.
VERY HIGH	> 40	Very high potential for phosphorus loss and adverse effects on surface and/or ground waters. All necessary soil and water conservation measures and a nutrient management plan must be implemented to minimize phosphorus loss from this field.

553

Table 4. Management options to minimize nonpoint source pollution of surface waters by soil P (from Sharpley et al. 2003).

P Risk Assessment	Management Options
< 10 (Low)	***Soil testing:*** Test soils for P annually to monitor buildup or decline in soil P, and to determine if plant available P meets crop requirements. ***Soil conservation:*** Follow good soil conservation practices. Consider effects of changes in tillage practices or land use on potential for increased transport of P from site. ***Nutrient management:*** Consider effects of any major changes in agricultural practices on P loss *before* implementing them on the farm. Examples include increasing the number of animal units on a farm or changing to crops with a high demand for fertilizer P.
10 to 20 (Medium)	***Soil testing:*** Test soils for P annually to monitor buildup or decline in soil P, and to determine if plant available P meets crop requirements. Conduct a more comprehensive soil testing program in areas identified by the P Assessment as most sensitive to P loss by surface runoff, subsurface flow and erosion. ***Soil conservation:*** Implement practices to reduce P loss by surface runoff, subsurface flow, and erosion in the most sensitive fields (i.e., reduced tillage, field borders. grassed waterways. and improved irrigation and drainage management). ***Nutrient management:*** Any changes in agricultural practices may affect P loss. Carefully consider the sensitivity of fields to P loss before implementing any activity that will increase soil P. Avoid broadcast applications of P fertilizers and apply manure only to fields with low P Assessment values.
21 to 40 (High)	***Soil testing:*** A comprehensive soil testing program should be conducted on the entire farm to determine fields that are most suitable for further additions of P. For fields with excessive P in soils, estimate the time required to deplete soil P to optimum levels for use in long-range planning. ***Soil conservation:*** Implement practices to reduce P loss by surface runoff, subsurface flow, and erosion in the most sensitive fields (i.e., reduced tillage, field borders, grassed waterways, buffers, and improved irrigation and drainage management). Consider using crops with high P removal capacities in fields with high P Assessment values. ***Nutrient management:*** In most situations involving fertilizer P, only a small amount used in starter fertilizers is needed. Manure may be in excess on the farm and should only be applied to fields with lower P Assessment values. A long-term P management plan should be considered.
> 40 (Very High)	***Soil testing:*** For fields with excessive P in soils, estimate the time required to deplete soil P to optimum levels for use in long-range planning. Consider using new soil testing methods that provide more information on environmental impact of soil P. ***Soil conservation:*** Implement practices to reduce P loss by surface runoff, subsurface flow, and erosion in the most sensitive fields (i.e., reduced tillage, field borders, grassed waterways, buffers, and improved irrigation and drainage management). Consider using crops with high P removal capacities in fields with high P Assessment values. ***Nutrient management:*** Fertilizer and manure P should not be applied for 3 years or more. A comprehensive, long-term P management plan must be developed and implemented.

554

Risk Assessment Worksheet 7/05

IDAHO PHOSPHORUS TRANSPORT RISK ASSESSMENT

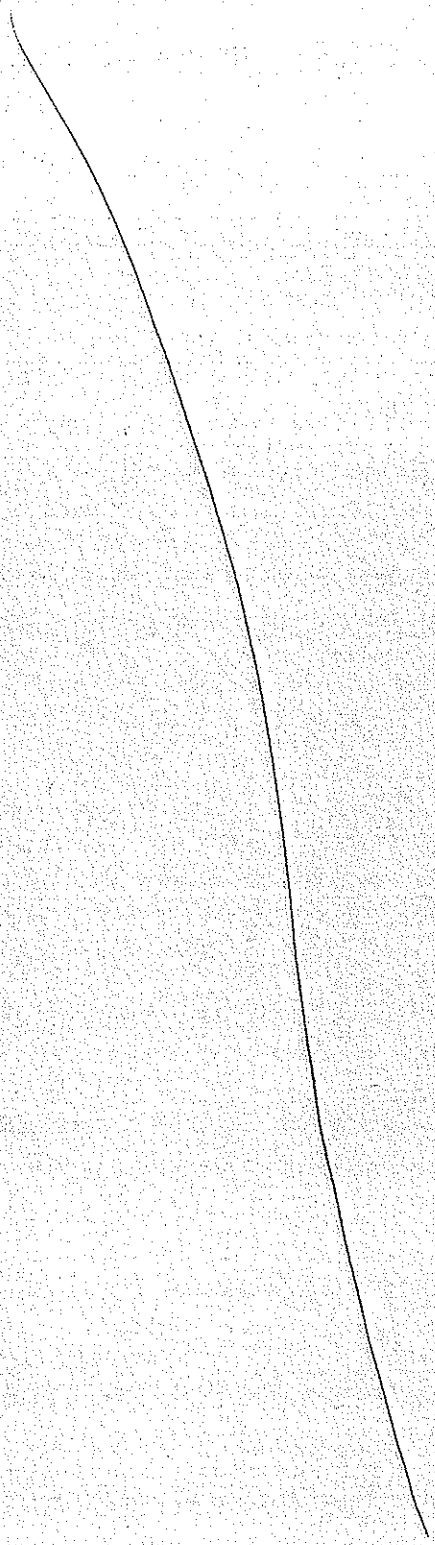
Landowner: _____ Date: _____ Pg: __ of __

Location: _____ Condition: Before _____ After: _____

Planner: _____ Field Office: _____

	A		B		C		D		E		F	
Tract												
Field(s)												
	Rating	Rating X FW	Rating	Rating X FW	Rating	Rating X FW	Rating	Rating X FW	Rating	Rating X FW	Rating	Rating X FW
Soil Test P *Factor Weight (FW) = 1.0*												
P Fertilizer Rate *Factor Weight (FW) = 0.75*												
P Fertilizer Method *Factor Weight (FW) = 0.50*												
P Organic Rate *Factor Weight (FW) = 1.0*												
P Organic Method *Factor Weight (FW) = 0.75*												
Runoff Index (Irrigated) **OR** Runoff Class (Not Irrigated) *Factor Weight (FW) = 0.50*												
Runoff Conserv. Practices *Factor Weight = 1.0*												
Soil Erosion *Factor Weight = 1.0*												
Distance to Water Body *Factor Weight = 1.0*												
Total Points												
Risk Level												

P Index Rating	Total	Site Vulnerability Chart
Low	< 10	Low potential for phosphorus loss. Some remediation measures should be undertaken to minimize the probably loss.
Medium	10 - 20	Medium potential for phosphorus loss. Some remediation measures should be undertaken to minimize the probability of phosphorus loss.
High	21- 40	High potential for P loss and adverse effects on surface and/or ground waters. Soil and water conservation measures and phosphorus management plans are needed to reduce the probability of phosphorus loss.
Very High	> 40	Very high potential for phosphorus loss and adverse effects on surface and/or ground waters. All necessary soil and water conservation measures and a phosphorus management plan must be implemented to minimize phosphorus loss from this field.



Nutrient Considerations In Conservation Planning Using OnePlan

Nutrient Cycling

Jason W. Ellsworth
UI Extension Soil Scientist

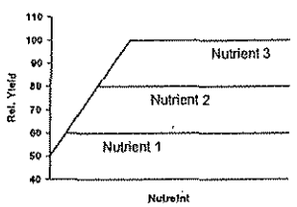
Essential Plant Nutrients

- Essential Plant *Nutrients*
  - Macro nutrients
  - Micro nutrients
- Roles of each

Nutrient	[ ] DM	Nutrient	[ ] DM
H	6.0%	Cl	100 ppm
O	45%	Fe	100 ppm
C	45%	B	20 ppm
N	1.5%	Mn	50 ppm
K	1.0%	Zn	20 ppm
Ca	0.5%	Cu	6 ppm
Mg	0.2%	Mo	0.1
P	0.2%		
S	0.1%	Co, Ni, Se, Na	

Crop Growth

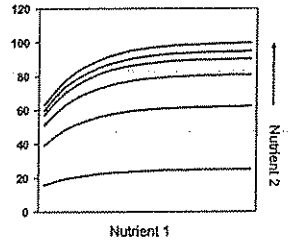
- Liebig's "Law of the Minimum"



557

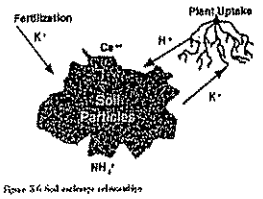
Crop Growth

- Mitscherlich – "Law of Physiological Relationships"



Role of Soils

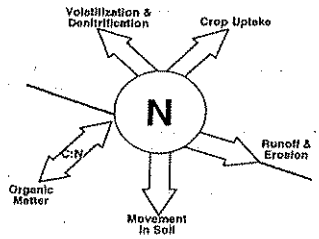
- Soil Exchange Relationships
- Soil Solution
  - Air
  - Water
- Roots
- OM
- Clays



Nutrient Cycles

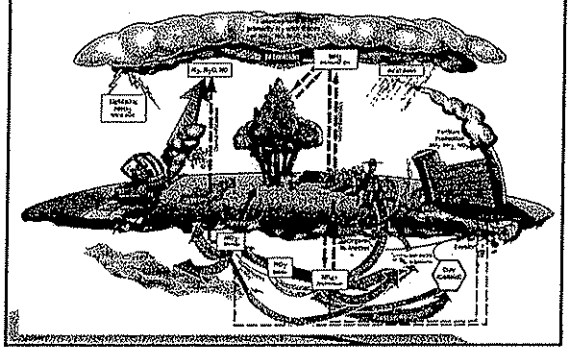
- Many "Cycles" that occur at the same time:
  - Carbon Cycle
  - Nitrogen (Sulfur) Cycle
  - Phosphorus Cycle
  - Potassium Cycle

Soil Nitrogen Cycle Simplified

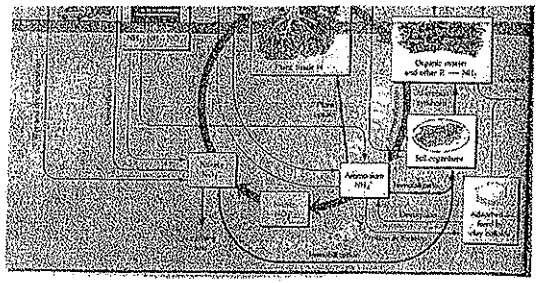


Simple Nitrogen Cycle

Nitrogen Cycle



Nitrogen Cycle



559

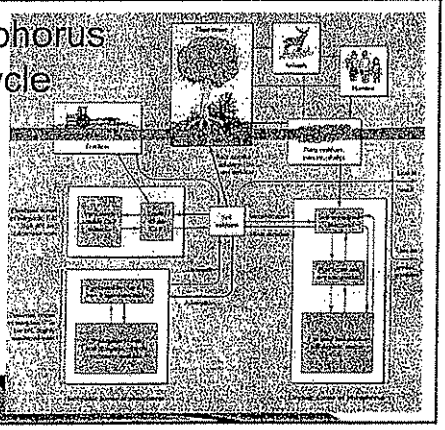
Common Processes

- Organic N → NO_3^- – Mineralization
- NH_4^+ → NO_2 → NO_3^- – Nitrification
- Organic N → NH_4^+ – Ammonification
- NH_4^+ → NH_3^- – Volatilization
- NO_3^- → N_2 + N_2O+NO – Denitrification
- Immobilization, Fixation (biological and mineral)

Agronomic Practices

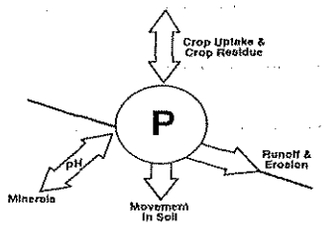
- Nitrification
- Leaching
- Volatilization
- Immobilization

Phosphorus Cycle



560

Soil Phosphorus Cycle Simplified



Simple Phosphorous Cycle

Common Processes

- **Mineralization**
- **Immobilization**
- **Fixation**

Nutrients and the Environment

- Processes that effect movement of nutrients:
  - Availability
  - Detachment
  - Transport

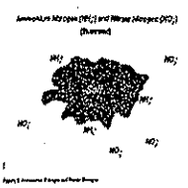
561

Nutrients and the Environment

- Processes that effect availability:
  - Adsorption
  - Precipitation
  - Transformation

Adsorption

- Attraction of compounds to the surface of soil materials



Precipitation

- Chemical combination of soluble species to form an insoluble compound
  - At high pH soluble phosphates react with soluble calcium to form relatively insoluble calcium phosphates

562

Transformation

- Change in chemical form of a compound (Chemical or Biological)
  - Urea nitrogen in manure can be transformed to ammonia nitrogen when applied to soil
    - At soil surface, ammonia is lost to atmosphere

Detachment

- **Processes that make nutrients or other materials available for transport**
- **Examples:**
  - **Runoff generates a sediment load**
  - **Water begins to percolate through the soil profile**

Nutrients and the Environment Transport

- Physical movement of a nutrient from one place to another
- Processes?
  - Runoff – solution
  - Runoff – adsorbed
  - Percolation

Pollution

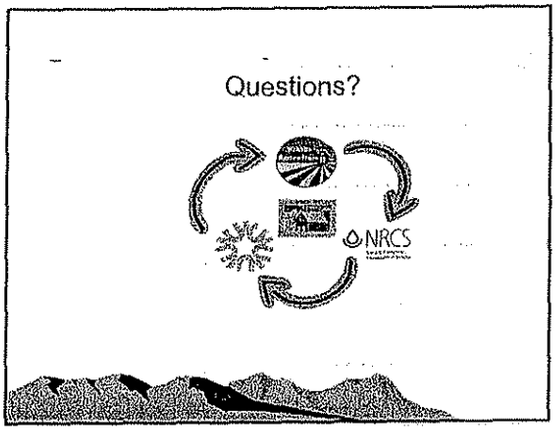
- What's a pollutant?
- A Nutrient out of place.

Environmental Risk

- The probability for there to be a negative impact of a pollutant on a sensitive (susceptible) area

Environmental Impact

- The effect of a pollutant on a sensitive area.
- Algal Bloom in surface waters
- Sediment load
- Economic Impact?


Questions?
NRCS